Dairy farmers' decision-making about their practices and production systems – to change or not to change?

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Dairy farming in New Zealand is a major contributor to the economy but is also a source of environmental degradation. Farmers perceive that the public perception of the dairy industry is negative, and that consumers in New Zealand are changing their consumption patterns to favour less meat and dairy products. There are also additional issues that may elicit stress for dairy farmers. Examples include high debt levels, increasing environmental regulation, and mental wellbeing. This study investigated dairy farmers' decision-making when considering whether to change practices or production systems in response to external stresses. The study set out to identify which practices or production systems dairy farmers choose to adopt or have adopted, and why, but also to synthesize these with theory to show the main processes involved in dairy farmers' decision-making.

An exploratory, mixed-methods approach was employed to address the objectives. The overall production systems under investigation were conventional, biological (including regenerative), and organic (including biodynamic). Semi-structured interviews were conducted with 15 conventional and 15 agroecological participants (seven organic and eight biological) in the first phase of the study. Based on the qualitative results from the interviews, a quantitative survey in the form of a web questionnaire was distributed nationally and answered by 173 respondents.

The Protection Motivation Theory was used as a starting point to develop a conceptual framework, which guided the methodological approach. Factors that were identified through literature review as important for farmer decision-making were also added to the conceptual framework. Analysis of the qualitative and quantitative data suggests a model governed by three overall processes that explain dairy farmers' decision-making in response to their subjective perception of: (1) stress on the farm system, (2) relative advantage, and (3) self-efficacy. These processes are moderated by intra- and interpersonal factors such as beliefs, social connectedness, and values. Finally, facilitating conditions, actual social norms, and actual behavioural control moderate behaviour. The entire model is influenced by the socio-physical context in which the decision takes place.

Despite data recruitment limitations, the quantitative data also suggest that 24% of currently conventional respondents were interested in adopting an agroecological production system in the future. Significant reasons for choosing these systems were lower environmental impact, preferred by consumers, and improves public perception. Similar reasons were also offered by conventional respondents for their choice of variations to their production system, such as lowering inputs or intensity, supplying value-add products or diversifying income streams.

There appears to be a general move towards adopting lower-input systems that improve profit and wellbeing rather than increasing production. The interest in adopting biological and non-certified organic systems indicates a perceived relative advantage that is not dependent on an external monetary incentive. To support the autonomy of farmers when choosing practices or production systems that suit them best, authorities are encouraged to acknowledge and research all available options and support local networks and peer-to-peer learning.

Keywords: dairy, decision-making, farmer, behaviour, change, adoption, profitability, stress, barriers, enablers, agroecology, organic, biological, regenerative, threat appraisal, coping appraisal, relative advantage, self-efficacy

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List of Abbreviations

DIRA	Dairy Industry Restructuring Act
IFOAM	International Federation of Organic Agriculture Movements
MfE	Ministry for the Environment – Manatū Mo Te Taiao
MPI	Ministry for Primary Industries – Manatū Ahu Matua
ODPG	Organic Dairy & Pastoral Group
OANZ	Organics Aotearoa New Zealand
PMT	Protection Motivation Theory
TIB	Theory of Interpersonal Behaviour
TPB	Theory of Planned Behaviour
VBN	Value-Belief-Norm Theory

1 Introduction

Dairy farming is one of the most significant primary industries in the Aotearoa New Zealand economy (Stats NZ, 2019). In the year ended December 2017, dairy farming contributed 15.2 billion NZD to the economy, mainly through exporting milk powder, butter and cheese. Together, milk powder, butter and cheese accounted for 28% of total export earnings that year (Stats NZ, 2018). Since 1991/92, the number of dairy cows and litres of milk processed have steadily increased (DairyNZ, 2018b) (Figure 1), indicating a growing industry.

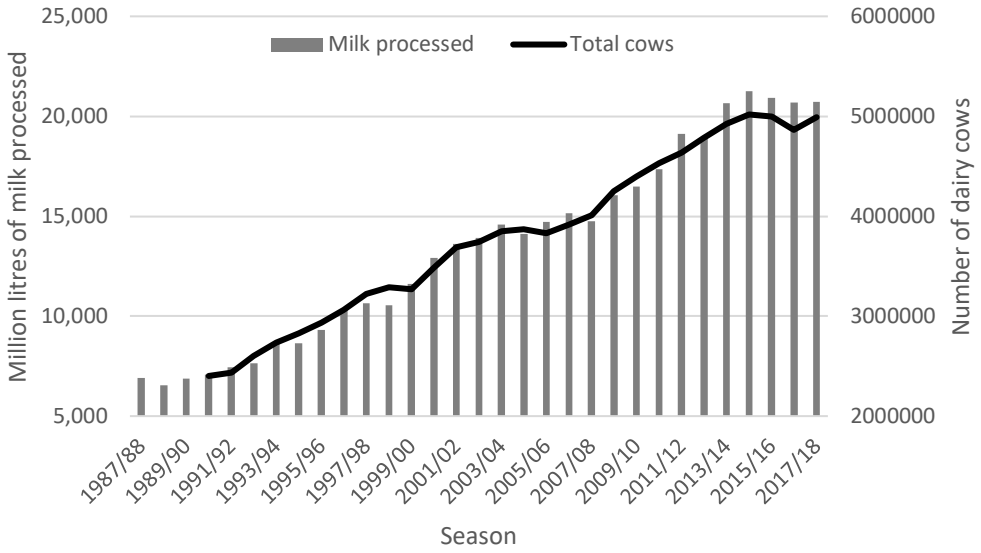

Figure 1. Growth of the New Zealand dairy industry between seasons 1987/88 and 2017/18 as measured by the number of cows and milk processed (data from DairyNZ, 2018b).

Every year, New Zealand exports about 95% of the milk it produces, although this only accounts for 3% of the total global production (DCANZ, 2019). Despite being a relatively small producer, New Zealand has a major market share in the world trade of dairy products; together, New Zealand and Australia account for more than 40% of world trade in dairy (Reisinger et al., 2014). It is essential for the New Zealand dairy industry to maintain good relations with its trading partners and to appeal to its international consumers due to its strong dependence on international trade.

New Zealand owes much of its export success to the 'clean and green' image that the country uses to market its products (MfE, 2001; Saunders et al., 2015). This image is often based on livestock grazing outdoors in a pristine, beautiful and unpolluted landscape. The reality is, however, different to the positive environmental image that is being portrayed, which may have serious implications for New Zealand's competitive advantage in export trade. Non-point source pollution of nitrogen (N), phosphorus (P) and faecal bacteria from agricultural lands are recognised as contributing to nutrient enrichment and declining water quality in many regions of New Zealand (Monaghan, De Klein, & Muirhead, 2008). Spreading freshwater contamination, increasing greenhouse gas

emissions and threats to biodiversity are also indications that environmental quality is in decline (OECD, 2017).

Dairy farming has been subject to a lot of negative publicity domestically regarding its impact on the environment and on the country's 'clean and green' image (e.g. Kedgley, 2014; MfE, 2001; O'Tracey, 2017; Piddock, 2017; Shepard, 2017). Due to public pressure and concerns over the negative impact on tourism, the Ministry for the Environment (MfE) outlined a target to make 90% of rivers and lakes swimmable by 2040 (MfE, 2017). They outlined many tactics to reach this target, one of which includes fencing off all waterways from dairy cows on all types of land by 2022. While developing the target, MfE had received nearly 4000 submissions indicating how important this issue is for New Zealanders (MfE, 2017). If the negative publicity spreads internationally, this is expected to have negative follow-on effects on the export value of associated goods and services (MfE, 2001). Furthermore, it has been calculated that the cost of a degraded environment and loss of social licence for dairy farming may perhaps exceed the dairy industry's contribution to GDP (Foote, Joy, & Death, 2015). These are serious challenges that the dairy industry, dairy farmers, and the Aotearoa New Zealand society as a whole are facing.

Mental health among farmers is also a major concern for the industry; 185 farmers committed suicide between 2007 and 2015 (Hutching, 2017). There are approximately 25 rural suicides per year, but Walker (2012) suggests in a review commissioned by FARMSAFE that the number of attempted suicides is 20 to 30 times higher than the number of completed suicides. High workload, lack of sleep, not enough time for oneself and family and friends, and financial stress from high levels of debt and uncertainty about being able to service the debt are the main factors negatively affecting farmer wellbeing (FARMSTRONG, 2018). Dairy farmers are highly indebted in New Zealand (Galloway, 2017) and many are reliant on an adequate milk price to stay profitable (Bird, 2014). Income uncertainty can represent another source of stress for farmers, seeing as milk prices change every season, and sometimes quite dramatically (Interest, 2019).

These stresses are but a few examples that dairy farmers in Aotearoa New Zealand are facing. Understanding how dairy farmers themselves perceive these stresses, and how they respond to them and why, is, however, unclear. This thesis aims to explore the response to these and other stresses by looking at dairy farmers' decision-making through their eyes taking contextual and intrapersonal factors into account.

1.1 The purpose of the study

Farmers may respond to stress on their farming system in a variety of ways, including minor adjustments to the current system to improve efficiencies, substituting one practice for another, or

a complete redesign of their system. These responses have been presented and discussed by Hill (1998) and Pretty et al. (2018) in terms of change towards more environmentally sustainable practices. In this study, sustainability includes financial, social and cultural aspects in addition to environmental, in acknowledgment that it is possible that a farmer takes all these aspects into account when assessing how to best respond to stresses. This widening of the concept is necessary to include all types of changes (change of practices or production system) that dairy farmers might consider.

When changing practices, it is essential that the farmer perceives that there is a relative advantage in doing so in order for motivation to perform the necessary changes to occur (Pannell et al., 2006). Changing or improving existing practices can be a positive choice, driven by a desire to adopt a system that is perceived to be more economically viable, more environmentally sustainable, or more enjoyable both socially and mentally. Conversely, changing practices may be driven by a desire to avoid ramifications of environmental factors (climate change and degraded water quality), financial factors (volatile milk prices and compliance costs), or social factors (stress and public pressure), for example. Of course, a farmer may also perceive that the system he or she currently operates is the most suitable and will not perceive any relative advantage or motivation to change.

The overall aim of this study is to understand dairy farmers' decision-making when considering whether to change practices or production system in response to external stresses. This will be achieved by addressing the following objectives:

1. To identify which practices or production systems dairy farmers choose to adopt or have adopted
2. To identify the reasons for these choices, in particular why dairy farmers choose to adopt agroecological production systems
3. To synthesize theory with the results from objectives 1. and 2. to show the main processes involved in dairy farmers' decision-making.

Investigating what options dairy farmers are considering is important as it can provide helpful direction for policymakers and industry bodies to support farmers in transitioning to different practices or production systems or in reaching other goals. The motivations behind those choices are equally important as it can shed light on how dairy farmers are envisaging the future of their industry and how they aim to get there. This would assist authorities in articulating a common vision towards which farmers and society as a whole can strive in an effort to improve overall wellbeing and sustainability.

The research can also shed light on the processes involved in decision-making, which could contribute to expanding theories on behavioural change. Changing practices or production system can be a high-risk and high-cost decision that may require a system redesign (Pretty et al., 2018) and a change of mindset (Gosnell, Chamley, & Stanley, 2020). To delve deeper into high-cost decision-making, this study will look into redesigns to agroecological production systems, such as organic, biodynamic, biological or regenerative. Since such a redesign is both knowledge- and skill-intensive, and requires an understanding of the farm as an ecosystem (Hill, 1998), the decision-making process is expected to be more complex than improving efficiencies, for example, due to the need to acquire new knowledge and skills, and adapt them to the specific farm context. It is suggested that the advantage and appeal of such a change must be very strong in order for the necessary motivation to be created and the change adopted. Specifically investigating this type of redesign is thought to more clearly reveal the decision-making process and the external and internal factors involved.

1.2 Structure of the thesis

The justification and purpose of this study has been outlined in this introductory chapter. The questions that each of the following chapters aim to answer is depicted in Table 1. Chapter 2 will give a general background on the challenges that exist in modern agriculture and the dairy industry in Aotearoa New Zealand. Alternative forms of agriculture are explored and explained as potentially viable production systems that dairy farmers are able to choose from. A literature review on farmer behaviour and the factors that can reasonably be assumed to have an influence on the decision-making process will be presented in Chapter 3. A conceptual framework that serves as the foundation for the methodological approach is also presented.

Chapter 4 will outline the research design and methodology used to investigate the research question and address the objectives. A mixed-methods approach was deemed to be most appropriate, starting with in-depth interviews with conventional and agroecological dairy farmers. The qualitative phase was complemented by a web questionnaire designed around the results of the semi-structured interviews.

Qualitative analysis of the semi-structured interviews with dairy farmers is outlined in Chapter 5. Contextual as well as intra- and interpersonal factors were found to affect three main decision-making processes. To support or reject these findings, a web questionnaire was conducted and the results of this are presented in Chapter 6. Some qualitative analysis of the respondents' suggestions on what support they might require to reach or maintain their ideal farming system is also presented here.

Chapter 7 starts with a brief discussion of the results from the interviews and the questionnaire. An evaluation of the results in relation to the methodology chosen is then outlined. This is followed by a detailed discussion of the theoretical implications of the qualitative and quantitative results in relation to the conceptual framework presented in Chapter 3 and wider literature.

Finally, in Chapter 8, the research questions and objectives are revisited and conclusions drawn based on the research findings. Recommendations for policymakers and suggestions for future research are lastly presented.

Chapter in thesis	**Questions to be explored in each chapter**
Chapter 2 *Literature review on challenges for agriculture and dairy*	What are the external factors/stresses/pressures experienced by dairy farmers in New Zealand? (i.e., what is the need for change?)
Chapter 3 *Literature review on behaviour change relevant to farmers*	What have other scholars said about how farmers make decisions and respond to stresses? (i.e. how do we expect farmers to respond?)
Chapter 4 *Methods and methodology*	How do we best answer the research question and address the objectives?
Chapter 5 *Qualitative results*	What are the types of changes that farmers are contemplating? Why these changes? (i.e. what is the relative advantage?)
Chapter 6 *Quantitative results*	Are the results from the qualitative phase supported or rejected by a larger subset of the dairy farming population?
Chapter 7 *Discussion*	What do the results from Chapters 5 and 6 tell us about the decision-making process of dairy farmers? What do they tell us about the motivation for a system redesign such as adoption of an agroecological production system? What are the theoretical implications?
Chapter 8 *Conclusion*	Why do these results matter? (i.e. what is the contribution of this research? What are the practical implications?)

Table 1. Flow diagram depicting the questions that each chapter aims to answer.

2 Literature review on challenges for agriculture and dairy

To fully understand the decision-making processes of dairy farmers in Aotearoa New Zealand when deciding on their production system, it is essential to explain the contextual and structural conditions underpinning the practice of dairy farming and how these may exercise pressure on dairy farmers. Therefore, this chapter will set the structural context around dairy farming in preparation for the next chapter, which will deal more closely with how stresses and internal factors interact to influence intention and behaviour.

Despite some contextual conditions being similar across farms in New Zealand, every farmer will, to some extent, experience a different set of pressures on their farm system consisting of a unique blend of factors that influence their feeling of resilience. For instance, some regions in New Zealand may be more threatened by extreme weather events than others or experience lower rainfall making them more dependent on irrigation; some farmers may feel less threatened by incoming regulations due to their current low level of inputs in comparison to other farmers; and some farmers may have high debt levels, whereas others have no debt at all. The farm-specific circumstances have an influence on the level of stress a farmer perceives his or her farm system to be under. The presence or absence of initiatives from industry bodies or authorities may influence whether a farmer feels confident enough to adopt new practices or a different system. How prevalent agroecological production systems are among the wider dairy farming population or in their region may also influence a farmer's willingness to adopt such a system. This part of the literature review thus aims to bring together a set of contextual factors and the interactions between them that may influence the decision-making process of dairy farmers in New Zealand.

This chapter starts with an overview of environmental, financial, and social factors that may influence farmers' choice of production system. Environmental factors such as climate change and water quality, financial factors such as debt, markets, and profitability, and social factors such as consumer trends and public perception are outlined in the first sections of this chapter. Following this, conventional and different types of agroecological production systems on a spectrum from biological to biodynamic are presented along with an estimation of how prevalent these systems are in Aotearoa New Zealand. Finally, a discussion on the premiums that exist for value-added products in Aotearoa New Zealand, and which dairy companies currently offer them, is presented.

2.1 Agricultural challenges

The current dominant agricultural system in the industrial world is high-input intensive food production (iPES-Food, 2016; Lichtfouse, 2009b), which has had severe impacts on the environment (Monaghan et al., 2008; Montgomery, 2017). The system is based on a paradigm of increasing

efficiencies through intensification without incorporating a deeper level of sustainability (Hill, 1998; Pretty et al., 2018). The high-input system of managing monocultures has evolved over the last 100 years through the use of modern technology and the development of chemical fertilisers, herbicides, and pesticides resulting in increased productivity of the land (Lichtfouse, 2009b).

The intensification of agriculture has allowed yield to be increased thereby enabling a greater portion of the population to be fed (Lichtfouse, 2009b; Montgomery, 2017), which is often considered a necessary means to an end in order to feed a growing world population (Alexandratos & Bruinsma, 2012; Tilman, Balzer, Hill, & Befort, 2011). If the estimates based on UN Statistics and presented by the physician and academic Professor Hans Rosling hold, the population will not increase past 11 billion by the end of the century (Rosling, 2019). The question would then be whether the world could feed 11 billion people without intensifying agriculture even further. Studies show that the planet already produces enough food for 10 billion people within our current agricultural systems (Holt-Giménez, Shattuck, Altieri, Herren, & Gliessman, 2012), but that waste and distribution of the produce and access to it remains a problem (Lal, 2020).

Farmers also face the challenge of profitability. It has typically been true that increased production leads to increased profits, but this is hardly a linear relationship. By increasing production, investments might have to be made, which may mean that a farmer has to borrow money from the bank. Increasing production may also result in a need to employ an extra member of staff, which also affects the bottom line (Mounsey, 2015). In sum, increasing production normally comes at a price and may not necessarily lead to increased profitability. A farmer must, therefore, weigh up the different options and evaluate what suits his or her system best and that of their family.

2.1.1 Climate and the environment

Nationally and globally, climate change and environmental degradation are threats to farm businesses and the society they operate in. Steffen et al. (2015) have estimated that humanity has crossed four out of nine planetary boundaries (the environmental limits within which we can safely operate) and that we are heading towards crossing further boundaries. The exceeded boundaries are climate change, land-system change, biosphere integrity, and biogeochemical flows. Biogeochemical flows include specifically the overuse of phosphorus (P) and nitrogen (N) as fertilisers on eroding soils that leach those nutrients to groundwater and freshwater (Steffen et al., 2015). Earth Overshoot Day, the date when humanity has consumed the resources generated by the planet in a given year, comes earlier every year (Global Footprint Network, 2017). This illustrates that we are overall continuously depleting the ability of the land to produce the natural resources that human beings are increasingly demanding. It is estimated that humanity currently

demands about 50% more than what the Earth can sustainably produce (Global Footprint Network, 2017). Land degradation is occurring at alarming rates and water quality and quantity is decreasing, due in major part to industrial agriculture (iPES-Food, 2016). In 2015, the ELD (the Economics of Land Degradation) Initiative reported that 52% of agricultural land was moderately or severely affected by soil degradation on a global scale (ELD Initiative, 2015). They further reported that 24% of global anthropogenic greenhouse gas emissions affecting the climate are a result of agriculture, forestry and other land uses. The number of environmental refugees, people forced to relocate due to the effects of climate change and other environmental issues, is steadily increasing (Cha-Sartori, 2011). Reversing climate change and environmental degradation is extremely important in order to maintain local and regional food production in areas around the world and minimise detrimental social and economic consequences.

The latest IPCC report stresses that global greenhouse gas emissions would have to be reduced by 40-50% from 2010 levels by 2030 in order to limit global warming to 1.5 °C, and to limit subsequent adverse consequences (IPCC, 2018). The implications of climate change for the primary industries include projected temperature increase, shifts in rainfall patterns, and rise in extreme weather events such as drought and flooding (IPCC, 2007; NZCCC, 2015). If production conditions change due to extreme weather events, for instance, it could have global consequences for food security. Aotearoa New Zealand is one of the world's top two exporters of dairy products, alongside the EU-28 (International Dairy Federation, 2018), and accounts, together with Australia, for more than 40% of international trade in dairy (Reisinger et al., 2014). A collapse of the New Zealand dairy industry could, therefore, have serious national and global ramifications.

New Zealand is, perhaps, particularly challenged by climate change due to its reliance on export of goods from the primary industries – especially dairy, where about 95% of all milk produced is exported (DCANZ, 2019). Extreme weather events, such as the droughts in 2012/13 and 2017 in some parts of the country, could adversely affect farmers' profit margin (Stats NZ, 2019) and create significant stress for farmers.

Due to the global nature of climate change and the recognition of shared responsibility, resource-rich countries such as New Zealand have signed international agreements (e.g. the Paris Agreement) to lower greenhouse gas emissions, which has influenced the creation of national legislation such as the Climate Change Response (Zero Carbon) Amendment Act (MfE, 2019). This may require implementation of more sustainable management practices on farms throughout New Zealand in order to meet national targets, keep the industry competitive and resilient, as well as keep farmers in a job that secures their livelihood and lifestyle.

2.1.2 Environmental regulation

Urban and rural populations alike were more concerned in 2017 about water pollution and quality than in 2008, an increase of almost 100% for both groups (MPI, 2017a). In response to increasingly polluted rivers and waterways and great media attention, Fonterra, regional councils, and the ministries for the Environment and of Agriculture and Forestry signed the Dairying and Clean Streams Accord in 2003. Fifteen years on, DairyNZ (2018a) reported that stock had been excluded from about 97.5% of all waterways on dairy farms and that 99.7% of stock crossing points had culverts or bridges. An increasing number of New Zealanders agree that "dairy farmers were committed to protecting the environment and water quality". In 2018, 53% of people agreed with this statement, in comparison to 33% in 2013 (DairyNZ, 2018a). Despite this positive development, there are indications that this has not turned the tide of environmental degradation. In their recent joint report *Environment Aotearoa 2019*, the MfE and Stats NZ (2019) [1] present a bleak picture:

- Almost 4 000 native species are under threat of extinction, which could have an impact on wellbeing, identity and cultural values. Agriculture, declining water quality, and climate change are listed as contributing factors; farming and urban expansion drive the clearing of valuable habitat for these native species, freshwater and ocean contamination is increasing due to toxicity and soil erosion, and climate change is changing the distribution of invasive pests.
- Land use change through clear-felling of forests for timber or agricultural purposes (such as pasture, which currently covers 40% of New Zealand's landmass) has increased soil erosion and compaction, which could lead to reduced soil productivity and a subsequent increase in demand for fertiliser.
- The expansion of urban areas onto the most productive land leads to the loss of high-class soil and habitat fragmentation. As much as 10% of the most productive land has irrevocably been lost since 1998 due to the development of lifestyle blocks.
- Waterways in both rural and urban areas are polluted with excess levels of nitrogen and pathogens that pose a risk to human and animal health. Intensification of farming with increased stocking rate, increased use of synthetic fertiliser and increased irrigation over the last 30 years are contributing factors. Between 1990 and 2015, the amount of nitrogen applied on farmland has increased six-fold.

[1] The issues listed here relate specifically to agricultural practices but the environment is also negatively affected by urban expansion, pollution from industry and manufacturing, and intensified fishing (MfE & Stats NZ, 2019).

- New Zealand has one of the highest rates of greenhouse gas emissions per capita in the world due to the large quantity of methane and nitrous oxide that is being emitted. Gross emissions from agriculture increased by 12% between 1990 and 2016. Overall, the gross greenhouse gas emissions in Aotearoa New Zealand increased by 20% during this time.

Environmental regulation is often used as a tool to alter the behaviour that causes environmental degradation as this has been shown to have a greater benefit and be less costly to society than restoring after degradation has occurred (Foote et al., 2015). Regulation could, for instance, be used to encourage farmers to decrease land use intensity (outputs per unit area), as it has been shown that de-intensification whilst retaining or improving profitability is feasible both in New Zealand and overseas (Antille, Imhoff, Alesso, Chamen, & Tullberg, 2015; Lienhard et al., 2014; Monaghan et al., 2004). Regulation can also be used to punish practices and behaviour that policy-makers deem inappropriate with regards to the goals and aspirations of the government (e.g. a fine for spilling effluent). Farmers' decision-making is likely to be highly affected by environmental regulation as their operations directly affect and depend on the environment. Regulations that restrict farmers' ability to operate freely can also be contentious and provide stress for farmers.

The level of risk an individual is willing to take is likely to have an impact on how that individual responds to uncontrollable risks such as policy changes, regulation, and market volatility. Approximately 95% of all dairy products produced in New Zealand are exported, making the industry vulnerable to foreign market forces and regulations (DCANZ, 2019; Treasury, 2015). This could act as a source of insecurity for dairy farmers, potentially making them more averse to taking risks. Due to circumstances outside peoples' control, they might sometimes feel forced to change their practices. An example of this is when the New Zealand subsidy system was abolished in 1984, and many farmers found it necessary to change practices, and sometimes even farming sector, just to stay financially viable as a business (Gouin, Jean, & Fairweather, 1994; Wallace, 2014). Wallace (2014) explains that complex decisions had to be made and structural changes initiated swiftly. In light of this, he states that it was often the attitude of the farm's decision-making unit, and how open they were to outside help and guidance, that determined whether the business would survive or fail.

Government and regional councils hope to motivate best environmental practices in the agricultural sector, since environmental degradation could threaten international trade due to the impacts on primary production (Small, Brown, & Montes De Oca Munguia, 2015). Regulations and interventions, such as imposing environmental regulations on agricultural discharges or taxing freshwater use (LAWF, 2015) are sometimes used in this way by policymakers in an effort to change

peoples' behaviour. Small et al. (2015) state that it is generally acknowledged that a mix of regulation and interventions are necessary to incentivise adoption of environmentally benign practices or enhance voluntary uptake among farmers.

While regulation can make certain changes in practices necessary in order to reach compliance, an alternative is to encourage the farmer to adopt certain practices through premiums. Marshall (2011) explained that monetary incentives or other forms of support from government will, however, not be successful in the long term unless the recipients know that the support will be withheld at some point. This is disputed by Wilkinson (2011), who argues that there is a greater risk of mal- or disadoption of the practice if and when the monetary incentive or support is withdrawn. Läpple and Kelley (2013) found that the impact of economic incentives and technical barriers varied a great deal depending on the strength of farmers' intention to convert to organic farming in Ireland. There is thus no one-size-fits-all approach that ensures compliance or voluntary uptake, since uptake may also depend on situational factors (Bewsell & Kaine, 2005; Small et al., 2015).

2.1.3 The 'clean and green´ image and consumer trends

The competitive advantage and success of dairy farming in Aotearoa New Zealand is (largely) based on the low-cost, pasture-based production systems employed in a temperate climate (Monaghan et al., 2008) and the 'clean and green' image portrayed internationally (Rauniyar & Parker, 1998). A large part of the New Zealand economy is dependent on international consumers willing to pay a premium price for products and services produced in an environmentally sustainable way. MfE commissioned a report in 2001 on the value of New Zealand's 'clean and green' image on three export sectors: dairy, tourism and organic foods. The first two were chosen as they were the two largest earners of export dollars at that time (MfE, 2001), and still were in 2018 (Stats NZ, 2018). They were also chosen because they have a direct impact on, and depend on, the health of the environment to thrive and develop (MfE, 2001). MfE (2001) reported that both industries would be negatively affected should New Zealand's 'clean and green' image become discredited, with an estimated annual loss of export earnings of $241-569 million for agriculture and $530-938 million for tourism. Saunders et al. (2015) affirmed that there is value in New Zealand's 'clean and green' image in their study of international consumers abroad who were shown to be willing to pay a premium price for export goods such as dairy products due to the 'clean and green' image New Zealand enjoys.

Articles, documentaries and news from reputable sources such as The New York Times, The Guardian, Reuters and Al Jazeera have reported on how the 'clean and green' image is far from reality (e.g. AingeRoy, 2019; Al Jazeera, 2017; Anderson, 2012; Tajitsu, 2013). As the MfE pointed

out as early as 2001, a discredited image could have serious financial repercussions for these industries and the nation as a whole. Awareness of this challenge may influence farmers' decision-making when choosing which practices or production system to operate.

The intensification and expansion of dairying in New Zealand (in Canterbury and Otago specifically) has led to significant public and media attention (Gray & Le Heron, 2010), which may have influenced consumer behaviour. The Colmar Brunton report *Better Futures 2016* (2017) reported that the issue of sustainability was increasingly influencing purchase behaviour. The report further stated that two of the top ten concerns of New Zealanders were (1) pollution of lakes and seas, and (2) protection and management of conservation lands and waters special to NZ (Colmar Brunton, 2017). In the most recent report with data from 2018, the pollution of lakes, rivers and seas came in sixth place of the top ten issues that New Zealanders care about (Colmar Brunton, 2019). This shows that water quality is currently of concern and something that New Zealanders take very seriously.

Reducing the use of plastic and favouring more plant-based foods were two other major trends that were linked to awareness of environmental issues in society. Four out of ten New Zealanders stated that they are committed to leading a more sustainable lifestyle (Colmar Brunton, 2019). It is likely that consumers may change their purchasing behaviour to mirror that commitment depending on how each individual defines sustainability and the options that are available to them. Eight out of ten people report doing this by using reusable bags when doing their shopping, reflecting the top concern of the build-up of plastic in our environment (Colmar Brunton, 2019). The second major trend was the adoption of a more plant-based diet where one out of ten New Zealanders reported that they currently always, or mostly, eat no meat. This is a steady increase from 4% in 2014 to 10% in 2018 (Colmar Brunton, 2019). This development could have serious implications for sectors within New Zealand agriculture if consumers are choosing less meat or dairy in favour of more plant-based products.

Consumers and employees are also increasingly demanding that businesses show social and environmental responsibility in order for them to work for such companies or purchase their products (Colmar Brunton, 2019). This shows a more ethical way of thinking and that consumers are more critical of so-called 'greenwashing'. One of the take-home messages from the *Better Futures 2018* report was that businesses should not ignore changing consumption patterns and behaviour. With increasing social connectedness, and the ease with which discontent or displeasure about an issue or product can be spread across society through social media, for instance, producers will need to respond to their consumers' concerns. The groups leading the trend towards

a more sustainable lifestyle in Aotearoa New Zealand are the younger generations, women, those with high income, those living in Canterbury, and households with children (Colmar Brunton, 2017). There is also a heightened awareness of animal welfare on farms, with consumers becoming less tolerant of "animals bearing the consequences of human failures" (DairyNZ, 2013, p. 25). Both urban (68%) and rural (73%) respondents agree that farmed animals are treated well by farmers in 2018, although these percentages have declined since 2008 (MPI, 2017a).

It is important to reflect on what impact these trends may have for New Zealand agriculture, and especially for the potential adoption of agroecological practices. In 2001, MfE (2001) described in their report *Valuing our Clean Green Image* how many consumers choose to purchase organic foods out of concerns over food safety. A more recent study conducted by Organics Aotearoa New Zealand (OANZ, 2018) found that, for 67% of consumers, the main reason for choosing organic products is to look after their and their family's health. Almost half (48%) of the consumers in that study chose organics out of concern for the environment and sustainability (OANZ, 2018). Being aware of these trends may have an influence on dairy farmers' perception of the organic production system and how their business might benefit from the adoption of it.

2.1.4 The 'urban-rural divide'

Due in part to the negative environmental impacts of dairy farming, there have been numerous reports, news articles, and social media statements on the growing so-called 'urban-rural divide'. The concept of a divide is used to explain apparent differences within a population, which is becoming increasingly urbanised, with fewer urban people having a direct connection to farming and how food is produced. In a survey from 2017, however, MPI reported that 50 and 47% of the rural and urban respondents, respectively, held positive views on dairy farming (MPI, 2017a). These numbers seem to have dropped since a similar survey in 2008 when 83 and 78% of rural and urban respondents held positive views on farming. Unfortunately, in that year, they did not differentiate between dairy farming and other types of farming as in the 2017 report, so it is difficult to tell exactly by how much positive views on dairy farming specifically have decreased. A more recent public survey (UMR Research New Zealand, 2019a, 2019b) of 1000 members of the general public showed that New Zealanders are more than twice as likely to hold a positive view of dairy farming (51%) than a negative one (20%). Despite what popular media are reporting, the MPI report and UMR Research suggest that the 'urban-rural divide', in reality, may not be as large as perceived. The views of urban and rural populations on issues such as pollution and concern regarding the environmental impact of dairying were shown to be similar between the two groups (MPI, 2017a).

2.1.5 Debt and fluctuating milk price

Another financial threat to the industry is the high debt load of farmers in Aotearoa New Zealand and the impact of fluctuating milk prices on this. Since the vast majority of dairy products are exported, the prices paid to New Zealand dairy farmers reflect fluctuations in the international price for whole milk powder set in global dairy auctions every two weeks. The volatility of that market means that there can be large variations in milk price from year to year (Interest, 2019; Stats NZ, 2019). This variability may have an impact on the decision-making process of farmers when deciding which farming system to operate.

Agricultural debt reached $60 billion in 2017, of which one third was carried by dairy farmers (Bradley, 2016; Galloway, 2017). Furthermore, about two thirds of that debt was held by one third of total dairy farmers meaning that some dairy farmers are highly indebted (Fraser, 2016). In order to pay off debt or service the interest, dairy farmers could be faced with choices, such as whether to increase or intensify production, lower operating costs, or hope for an increase in milk pay-out. Dave Hutchison, Westpac manager of corporate agribusiness, said that "the downturn in dairy returns over the past few seasons had contributed to a lift in agricultural debt" (Galloway, 2017). The downturn Hutchison refers to happened in the 2014/15 and 2015/16 seasons when the Fonterra milk price was $4.40 and $3.90 per kilo of milksolids, respectively (Interest, 2019). This is very low compared to the average Fonterra milk price of the previous five seasons which was $6.80 (range: $5.84-8.40) (Interest, 2019). Much debt was incurred during these years as banks were optimistic that milk prices would stay high and were thus comfortable lending money to dairy farmers for investment in their farm businesses.

Rabobank, which is the third-largest rural lender in NZ, stated in 2015 that with average operating costs at $4.50, farmers would not be able to service their already existing debts (Gudsell, 2015). With the drop in milk prices in the 2014/15 season, operating profit per hectare decreased by 53% for owner-operators and 65% for sharemilkers (DairyNZ, 2016). For owner-operators, the total business profit per all effective hectares before tax declined 76% (DairyNZ, 2016). Business profit differs from operating profit in that the cost of borrowing and other farming activities, such as off-farm income, labour adjustments, and interest, are also taken into account (DairyNZ, 2019c). Figure 2 shows the impact that a volatile milk price can have for dairy farmers in terms of business and operating profitability. Cronshaw (2015) reported that Canterbury dairy farmers were "among the most heavily indebted farmers in the world".

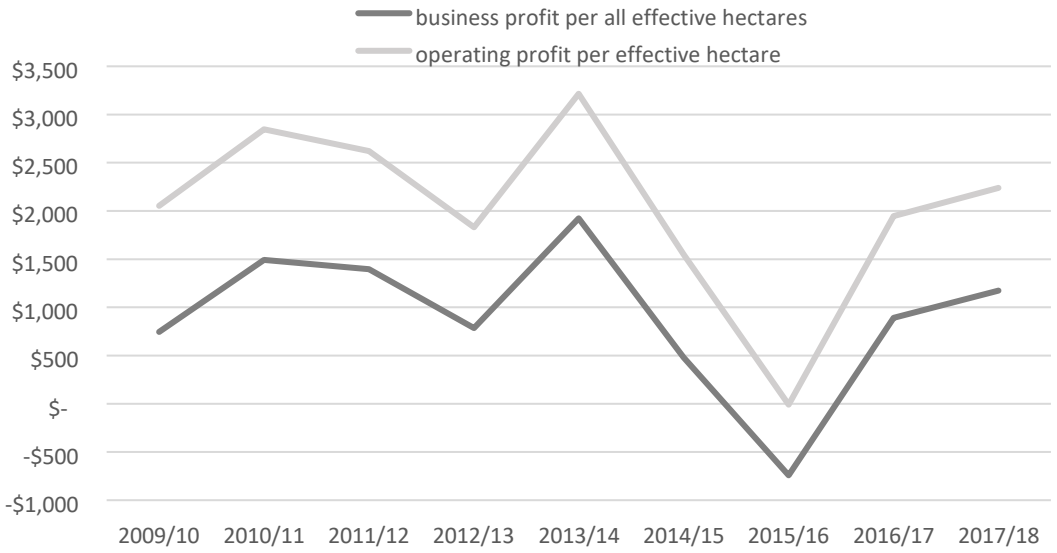

Figure 2. New Zealand dairy farmers' average operating profit and business profit adjusted for inflation from 2009/10 to 2017/18 (data from DairyNZ, 2014, 2019c).

2.1.6 Mental wellbeing

The challenges discussed above can have an influence on farmers' wellbeing, which may create an additional pressure to, if possible, change behaviour or in other ways address the challenges at hand. Being indebted could, for instance, lead to significant amounts of stress and mental health problems. In 2015, the Mental Health Foundation and rural insurer FMG founded the rural wellbeing programme FARMSTRONG to help combat these issues. FARMSTRONG's report (2018) suggests that high workload, lack of sleep and not enough time for oneself and family and friends are the main factors that negatively impact younger farmers' wellbeing. Many farmers mentioned financial issues as a source of stress which could lead to increased workload by not being able to employ staff or by increasing the number of stock on the farm to improve profitability (FARMSTRONG, 2018). Walker (2012) presents findings that showed that suicide was the second largest cause of death on dairy farms (32%) after motor vehicle crashes between the years 2007 and 2011. The report further suggests that dairy suicides committed in spring could be related to high workload and fatigue whereas suicides committed in autumn could be related to financial issues or impacts of weather events such as drought.

The perception that there is an 'urban-rural divide' can also lead to decreased wellbeing among farmers. Social media and online campaigns against dairy farming are common features leading to distress and distrust. The study by FARMSTRONG (2018) found that young farmers' stress levels were negatively affected by the portrayal of farming in the media and among the general public. Furthermore, the study found that more than 60% of the young farmers (both men and women) reported that these negative perceptions have a moderate to large or even greater impact on

wellbeing. It is clear that public perception is a stress factor for many farmers, which may have an impact on their decision-making.

2.2 Conventional and agroecological production systems

The challenges or stresses described above are examples of factors that may be perceived as threats or opportunities by farmers, depending on their business and overall farm context. If a farm business owner experiences distress due to one or several of these factors (or others not specifically outlined here), they may consider changes to their operation in an effort to make it less vulnerable and more resilient. Conversely, eustress (positive stress) could also be brought on by the perception that an exciting opportunity has emerged due to these challenges, which can act as a motivator to change.

How resilient and sustainable a farming system is perceived to be is determined by the individual and depends on the unique financial, social and environmental conditions and circumstances on each farm. Resilience has been defined as "the ability of a system to absorb disturbances and still retain its basic function and structure" (Walker & Salt, 2006, p. 1). In an area stricken by drought, one farm might suffer serious damage to the business, whereas another might only be slightly affected – the degree of resilience being the difference. Running a production system that is resilient to financial, social, and environmental changes is likely to be a goal for most farmers. Considering these aspects from a resilience point of view requires an appreciation that social systems are embedded in ecological systems, and that resilience thinking is an important tool for sustainable development (Darnhofer, Fairweather, & Moller, 2011; Pisano, 2012). Sustainable development lies at the nexus of economy, society and environment, and "seeks to meet the needs and aspirations of the present without compromising the ability to meet those of the future" (WCED, 1987, p. 39). The definition highlights a long-term perspective, which implies that systems must be designed to function within financial, social, and environmental constraints.

To farming families, sustainability might mean acting in a way that ensures their permanence on the farm (Ohlmer, Olson, & Brehmer, 1998; Vanclay, 2011). Farming is often an inter-generational business and lifestyle where farmers' main objectives, aside from earning enough to provide a similar living standard to those in their community, could be to pass on the farm as a viable business to the next generation (Barr, 2011) and leave the farm in a healthier environmental state. Farmers may have to adapt practices on the farm or change their practices or production system in order to reach their goals, regardless of what these are, in response to external conditions as previously described. The following sections describe the most common production systems that are currently

being practised in Aotearoa New Zealand from which dairy farmers can choose, namely conventional, biodynamic, organic, biological, and regenerative.

2.2.1 Conventional

Conventional (orthodox or mainstream) agriculture is characterized as a curative and chemical approach to problems in agriculture; for every problem there is a solution that can be found in the form of a product or device that can be applied to the problem area (Hill, 1998). One example is the efficient use of pesticides for pest control; another is improving fertility of the land with the use of synthetic fertilisers. This type of production system has also been called industrial due to the emphasis on efficient and maximum production at low cost with a reliance on the use of (often imported) input-intensive methods, simplified monocultures and specialisation (Hill, 1998; Shennan et al., 2017).

It is important to note, however, that there is a range of different conventional systems from high-input to low-input with varying dependence on synthetic fertiliser and brought-in feed for livestock (see Section 6.2.2 for an overview). Different intensity systems have been reviewed by Mounsey (2015) in relation to profitability who found that no system is more profitable than the other. The difference in profitability was related to management, which indicates that all types of systems have merit.

The merits and challenges of comparing conventional systems to organic systems is well reviewed by Shennan et al. (2017), who points out that the real-world variation within each system category is insufficiently considered in most studies. It must, therefore, be acknowledged that not all conventionally operated dairy farms will be associated with detrimental environmental impacts, or financial and social issues arising from increasing debt, and hence do not contribute to negative public perception of dairy farming. In light of the diversity within each system, we might ask how useful such a grouping is, which is a topic that will be discussed in detail in Section 7.1.

2.2.2 Agroecological alternatives

There is a multitude of production systems that share desired outcomes and provide an alternative to conventional production systems. Pretty (2006) presented four main principles that alternative production systems must address in order to be sustainable in the long term. These are:

- “integrate biological and ecological processes such as nutrient cycling, nitrogen fixation, soil regeneration, allelopathy, competition, predation and parasitism into food production processes,
- minimise the use of those non-renewable inputs that cause harm to the environment or to the health of farmers and consumers,

- make productive use of the knowledge and skills of farmers, so improving their self-reliance and substituting human capital for costly external inputs,
- make productive use of people's collective capacities to work together to solve common agricultural and natural resource problems, such as for pest, watershed, irrigation, forest and credit management." (Pretty, 2006, p. 4)

Agroecological production systems are commonly proposed as more environmentally sustainable alternatives to conventional systems. Agroecology is defined as "an ecological approach to agriculture that views agricultural areas as ecosystems and is concerned with the ecological impact of agricultural practices" (Merriam-Webster, 2019). Examples of agroecological practices include integrated pest and nutrient management, agroforestry, conservation tillage, and livestock integration using holistic grazing management (National Regenerative Agriculture Day, 2019; Pretty, 2006; Savory, 1999). The characteristics of agroecological production systems can differ, but they share the attempt to minimise negative environmental impact on biodiversity and abiotic factors by using as little external and synthetic chemical input as possible (Altieri & Koohafkan, 2008; Ensor, 2009). These systems tend to be multi-functional and can also have positive effects on social capital by strengthening communities and by providing increased demand for labour (Pretty, 2006). Practitioners are also often able to maintain or increase their profit margin when converting from conventional practices (Foundation for Arable Research, 2009). All three pillars of sustainability has thus the potential to be addressed by adopting agroecological practices.

Studies suggest that agroecological production systems such as biological and organic farming can be financially viable alternatives to conventional farming (e.g. Ghorbani, Wilcockson, Koocheki, & Leifert, 2009; MacRae, Frick, & Martin, 2007; Massey University, 2004; Schiefer, Lair, & Blum, 2015). The biodiversity loss, pest incidence, and environmental degradation that high-input, intensive agricultural systems can create could potentially be avoided through the adoption of different practices that, for example, use less chemical inputs, increase crop and pasture diversity, or reduce tillage (Lichtfouse, 2009a, 2009b; Runyon, Tooker, Mescher, & Moraes, 2009; Stagnari, Ramazzotti, & Pisante, 2009). Healthy ecosystems deliver a wide range of ecosystem services, such as pollination, nutrient cycling, climate regulation, water purification, erosion prevention and cultural and aesthetic benefits. These ecosystem services support key elements of wellbeing - subsistence, protection, affection, understanding, participation, leisure, creation, identity and freedom, as well as material wealth (Roberts et al., 2015). Practices that help restore on-farm ecosystem services are thus likely to have a positive impact on human wellbeing. Field trials and laboratory studies based on biodiverse agroecological approaches have provided evidence that agroecological

approaches can aid in combating both the causes and effects of climate change and enhance environmentally and socially sustainable access to food on a global scale (Ensor, 2009).

What follows below is a brief presentation of four agroecological production systems that are practised in New Zealand, namely biodynamic, organic, biological, and regenerative production systems. A common feature of all four systems is that they involve a focus on healthy, biologically active soils (Wallwork, 2011).

Biodynamic and organic

Biodynamic farming was founded by the Austrian scientist and philosopher Rudolf Steiner in 1924 in response to how he saw western civilisation destroying the land and, by extension, the people who live on it (Biodynamic Association, 2019). He noticed that farmers who adopted synthetic fertilisers and pesticides lost soil and plant health over time, which had an impact on animal health and the nutritional value of the food produced. Steiner taught farmers to view the farm as a closed, diversified ecosystem that should integrate livestock and crops to improve fertility, and to be mindful of the influences from the cosmos and the earth (Biodynamics New Zealand, 2019b). Biodynamic farmers use homoeopathic preparations to improve the fertility and immune system of the land.

Biodynamic and organic production systems are intimately related, as organics originated out of the biodynamic movement. The term 'organic' was coined in the 1940s by Baron Lord Northbourne, an agricultural professor at Oxford University in England, who was a biodynamic farmer. The term was popularised by the American Jerome Rodale through his magazine *Organic Gardening* in 1942 (Demeter Association, 2009). Organic production typically means farming without synthetic fertilisers, herbicides, and pesticides. Instead, it relies on practices such as crop rotation, composting and using animal and plant manures as fertilisers, biological pest control, and rotational grazing (Rodale Institute, 2019). In New Zealand, organic production is defined as farming using methods that meet the standards set by the certification bodies with international approval by IFOAM (International Federation of Organic Agriculture Movements) (Fairweather, 1999). The official definition used by IFOAM reflects the four principles of organic agriculture - health, ecology, fairness and care:

> *"Organic Agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic Agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved." (IFOAM, 2019)*

Biodynamic farming is a form of organic farming that more resembles a closed ecosystem with very limited external inputs, such as feed (Biodynamics New Zealand, 2019b). The farm system is seen as a living whole, and biodynamic sprays are used to stimulate biological activity in the soil (Biodynamics New Zealand, 2019b). Biodynamic practitioners also often base farming activities on lunar cycles (Biodynamics New Zealand, 2019a). In New Zealand, the biodynamic certification Demeter can be obtained from the Bio Dynamic Farming and Gardening Association, and the organic certification can be obtained from certification agencies BioGro and AsureQuality. To be allowed to market farm products using the certification body's logo, both organic and biodynamic farms are subject to regular external audits in order to remain certified (Biodynamics New Zealand, 2019b; Soil Association, 2017).

The advantages and disadvantages of, and reasons for adopting organic production systems have been studied extensively (e.g. Darnhofer, Schneeberger, & Freyer, 2005; Foundation for Arable Research, 2009; Läpple & Kelley, 2013; Pechrová, 2014). Organic agricultural systems are probably best known for their positive impact on biodiversity (Fuller et al., 2005) and potential loss of yield in comparison to conventional systems (Gabriel, Sait, Kunin, & Benton, 2013). In New Zealand, Massey University (2004) published a booklet titled *Converting to Organic Dairy Production* in which they outline how organic practices may improve soil composition and pasture productivity by supporting and encouraging healthy biological activity in the soil. Organic farms also do not use antibiotics routinely, which is claimed to improve animal welfare (Soil Association, 2017). Studies comparing conventional and organic dairy farms in New Zealand conducted by the Agricultural Research Group On Sustainability (ARGOS) have found that there was no statistically significant difference in financial performance between study farms despite conventional farms producing higher amounts of milksolids (ARGOS, 2006). ARGOS (2006) found that this result can be attributed to organic farms being able to cut operating expenses (fertiliser, feed, animal health inputs) in contrast to conventional dairy farms. Similar results have also been found in Canada (Stonehouse, Clark, & Ogini, 2001) and Spain (Argilés & Brown, 2010).

Biological and regenerative

Biological and regenerative farming systems are often seen as a middle way between organic and conventional farming (Jefferis, 2010; Merfield, 2019). Whereas certified organic and biodynamic farmers have to adhere to strict rules and guidelines, and focus on inputs, there is no certification available for biological and regenerative farmers who instead focus on outcomes and are able to be more flexible in their management (Merfield, 2019). Merfield (2019) notes that current biological and regenerative systems are hard to define as the concepts are only 10-20 years old and still evolving. There are, however, differences between the two systems.

Biological farming started to become a topic of research and farming ideas in the USA in the late 1990s (Le Heron, Smith, Le Heron, & Roche, 2016), but its emergence in New Zealand took longer. In 2012, it was reported that there was a growing interest in biological farming in New Zealand, although individuals called for more scientific research to be brought forward in order for evidence-based discussions to take place about the benefits of biological farming (NZ Biological Farming Systems Research Centre, 2012). Although production systems vary greatly within each category and overlap, Magesan and McFadden (2012) made a simplified but useful comparison between conventional and biological dairy farming systems that can be viewed in

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Table 2. A simple comparison between conventional and biological production systems (Magesan & McFadden, 2012).

The South Island Dairying Development Centre (SIDDC) led a research project comparing a biological and a conventional dairy farm in New Zealand since the 2012/13 season. The monitoring of pasture and animal production over the past seven years shows that both farms grew similar amounts of dry matter, although 20% less nitrogen was applied to the biological farm as fertiliser (SIDDC, 2019). As a result, there was a higher clover content on the biological farm's pastures. The biological farm also had fewer animal health problems with cows showing fewer nutrient deficiencies than on the conventional farm. The biological farm had higher fertiliser costs (due to the higher cost of the biological fertiliser used), but these were offset by the improved animal health and better reproduction rates on the biological farm (SIDDC, 2019). The interim results suggest that productivity and economic performance were similar on both farms, but that animal health and environmental performance was better on the biological farm[2].

[2] The final report for this project is not yet published, so these interim results cannot be validated at the time of writing.

Regenerative agriculture can be seen as a form of biological agriculture that seeks to improve overall ecosystem health and function by improving soil health. The term regenerative is linguistically different to the term sustainable and refers to the desire to repair or make something better, as opposed to simply maintaining practices that perhaps lead to negative outcomes (Merfield, 2019). Regenerative agriculture incorporates many different practices that will be particular to a farmer's holistic goals for their business. Minimising disturbance such as no-till, minimising bare soil at all times, increasing diversity in crops or swards, and integrating livestock and cropping operations are elements that are similar across regenerative systems (Lacanne & Lundgren, 2018; Lal, 2020). Implementing these practices can improve levels of soil organic matter and increase water holding capacity (Gosnell et al., 2020; Teague et al., 2016; Teague et al., 2011). Regenerative management of soil systems seeks to sequester carbon, build organic matter (some farmers have managed to build soil organic matter (SOM) at a rate of 0.5 to 2% per year (Advancing Eco Agriculture, 2019; Brown, 2018)), regenerate plant and soil health, produce functional food as medicine and regenerate human health (Provenza, Kronberg, & Gregorini, 2019).

It is claimed that regenerative agriculture ecosystems are capable of reducing or completely eliminating synthetic inputs such as fertilisers and pesticides (Advancing Eco Agriculture, 2019; Rhodes, 2012). Renowned soil ecologist Dr. Christine Jones conveyed in an interview with Acres U.S.A. that "regenerative agricultural systems provide remarkable benefits for biodiversity, carbon sequestration, nutrient cycling, water management and productivity" (Frisch, 2015, p. 1). Lacanne and Lundgren (2018) also showed that regenerative farmers were able to increase profitability and provide greater ecosystem services than conventional farmers. Although yield was lower in regenerative fields, profitability was 78% higher than in conventional fields and was correlated with the level of soil organic matter in the soil. Pest incidence was also lower in regenerative fields.

2.2.3 Differentiating agroecological systems

Not every organic or biodynamic producer is certified and there can be great differences within organic and biodynamic systems. Even within certified organic production systems, there is great variability in how farmers approach and include the organic principles (Dinis, Ortolani, Bocci, & Brites, 2015; Fairweather, 1999). There is criticism that the certification itself can ignore social values, nutrient recycling and issues relating to biodiversity. The focus has, instead, been on prohibiting substances, which may lead farmers to substitute inputs to achieve the certification rather than incorporating organic practices such as crop rotations into a system redesign (Dinis et al., 2015; Hill, 1998). This is important to keep in mind when analysing the production systems that farmers are operating. Due to this spectrum within the organic category, some researchers suggest that organic certification does not necessarily lead to more sustainable practices on farm, creating

two groups: 'deep organic' and 'organic lite' (e.g. Dinis et al., 2015; Guthman, 2004). Dinis et al. (2015) explain that this divide is a result of 'conventionalisation' by large agri-business corporations entering the organic market as consumer demand has grown, undermining the organic principles as reasons for adopting this type of system.

A similar situation exists for biological and regenerative agriculture. It is difficult to find official definitions of biological and regenerative systems, which is probably a result of these systems being relatively new and there currently being no agencies or authoritative bodies that certify them. The same way that organic agriculture once developed from a group of like-minded farmers, biological and regenerative practitioners are currently in that stage of a grass-roots movement. Due to the undefined nature of biological and regenerative systems, there is a spectrum within each category; there may be great differences between two biological systems. On one end, a farmer might simply be substituting inputs and including biological products whereas on the other end another farmer might redesign the farming system, incorporating more biological practices such as cover crops and livestock integration. For example, at a biannual field day at the SIDDC biological farming research trial mentioned previously, some biological practitioners claimed that the system adopted mainly involved substitution of biological products for conventional ones, rather than adoption of a truly biological system (Pers. comm., Field day attendees, 2017, 13th December). These practitioners suggested that the difference between the conventional and biological farms would be more apparent if the farmer had adopted more aspects of the biological production systems. Since regenerative farming has been described as going beyond the organic standards, as it focuses on regenerating natural resources as well as improving soil health, animal welfare and social fairness (Rodale Institute, 2019), regenerative farming could be termed 'deep biological'. Figure 3 summarises diagrammatically the differences and overlap between all five different systems.

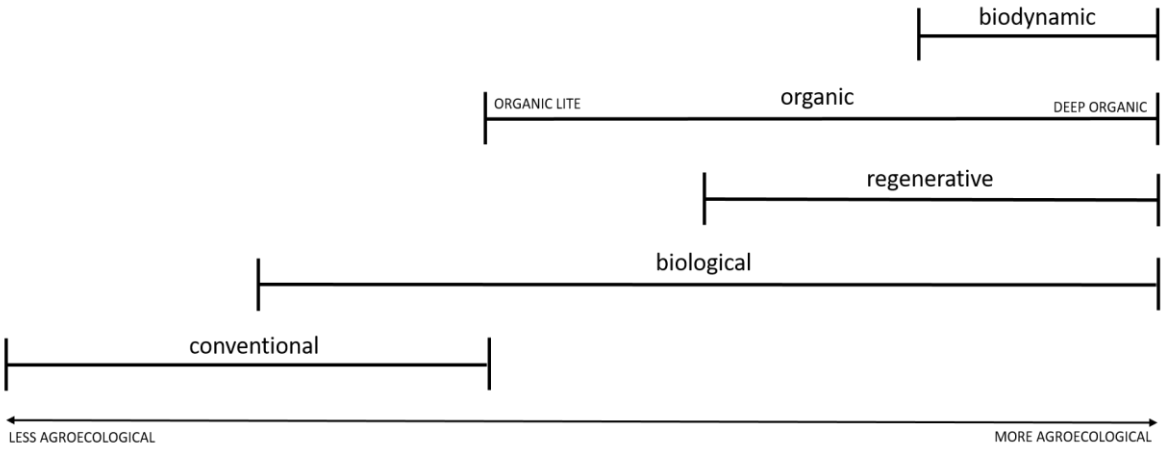

Figure 3. A conceptual visualisation of the differences between the five production systems under investigation.

2.2.4 Number of agroecological practitioners

There are currently no standardised records of the number of farmers in New Zealand that are adopting different types of agroecological practices. The number of dairy farmers contracted to supply organic milk in New Zealand has fluctuated quite dramatically in recent years, depending on what dairy processing options have been available, but the total number at any one time is difficult to establish as there is no centralised record. At its peak in 2011, Fonterra (the largest dairy company in Aotearoa New Zealand) had contracted 127 dairy farmers to supply organic milk, but this dropped to 74 in 2014 due to a change in company policy (OANZ, 2018; Organic Dairy Hub, 2017) and the number was "more than 50" two years later (Hutching, 2016). Around the same time, the Organic Dairy Hub, which is a small dairy cooperative who exclusively process organic milk, had 18 organic suppliers (Organic Dairy Hub, 2017). Some smaller suppliers process and directly market their milk products such as Clearwaters Organic Dairy Co, Kawerau Dairy, Biofarm Products, and Jersey Girl Organics (OANZ, 2018). According to the third-party agencies for organic certification, BioGro and AsureQuality, approximately 29 and 84 organic dairy farmers respectively were registered in May 2019 (AsureQuality, 2019; BioGro, 2019) giving a total of 113.

There are, however, other certifying bodies like Organic Farm NZ, which is a less expensive national certifying program created especially for smaller operators such as hobby farms, lifestyle blocks, retailers, and community gardens up to 100 ha (Organic Farm NZ, 2014). Producers certified through this agency supply the domestic market and are certified through peer evaluation, which is not recognised by IFOAM. These producers can therefore not export their products internationally, whereas producers certified through the third-party agencies BioGro and AsureQuality can (MPI, 2017b; Organic Farm NZ, 2014). There were 130 producers registered with Organic Farm NZ in 2014, of which the number of dairy farmers is not reported (Organic Farm NZ, 2014). The total number of currently certified dairy farms is therefore difficult to tell. Additionally, there may be dairy farmers that consider themselves organic or biodynamic but have not certified their business. Based on these estimations, the total number of certified and uncertified dairy farms in Aotearoa New Zealand is likely to be in the range of 200-400. In comparison to the total number of dairy farms in New Zealand, 11 540 in year 2017/18 (DairyNZ, 2018a), organic producers are a minority group.

In May 2019, there were two farms that were certified for producing biodynamic, full-fat cow milk according to the Demeter database (Demeter, 2019). Only producers who have opted to be part of the database are listed, however, so more dairy farmers who are certified biodynamic may exist alongside those who adhere to the rules of biodynamic farming but have chosen not to certify their business. It is also possible for a farm to be certified both organic and biodynamic. Indeed, one of

the two Demeter certified farmers also appears on the BioGro database of certified organic farmers (BioGro, 2019).

Becoming certified organic or biodynamic is a process that may take many years to complete. In the meantime, dairy farmers might move towards more biological or regenerative management practices through changes in input levels such as reducing pesticide, herbicide and other chemical use, introducing cover crops, and moving to no-till. Some might not be interested in becoming certified and may adopt an agroecological system purely because of other financial, social or environmental benefits they perceive their chosen system brings. Because there is no overarching organisation where biological and regenerative, and uncertified organic and biodynamic practitioners are registered, it is difficult to know the numbers of farmers who have adopted these systems. Anecdotally, there were approximately 100 farmers in New Zealand who were biological producers in 2015 (Kiwi Bharat, 2015). Speaking at the Organic Dairy & Pastoral Group (ODPG)[3] conference in March 2019, Roger Beattie of R&N Partnership claimed that as many as 10-20% of all farmers today may be biological, whereas 15 years ago perhaps only 1% were (Beattie, 2019). Le Heron et al. (2016) estimated that in 2010, there would have been 1 500 dairy farmers experimenting with alternatives to the conventional synthetic NPK (nitrogen, phosphorous, and potassium) applications. How many of these would have defined their system as biological is, however, unknown.

2.3 Premiums for value-added dairy products

For any of the systems above to become adopted by farmers, the relative advantage and benefits of the chosen system have to be clear. Premiums offered by dairy companies for a certain value-added product may be one incentive that farmers respond to. Fairweather (1999) suggested in the late 1990s that if economic and technical viability of organic farming was overcome (as well as farmers' attitudes to change), it could facilitate conventional farmers' conversion to organic farming at a faster pace. Financial capacity could, therefore, act as a facilitating condition to changing practices and is an important factor to consider when investigating reasons for choosing particular practices or production system.

2.3.1 Organic market potential

Probably the most well-known premium available is that for organic products. Organic certification was a major marketing trend both internationally and domestically in 2001 (MfE, 2001), and the market continues to develop (OANZ, 2012, 2016, 2018). Figure 4 shows the development of the organic export industry since 1990 in monetary terms. The export value has increased from virtually

[3] The ODPG is the New Zealand representative body for organic producers of livestock and cropping (ODPG, 2019).

nothing in 1990 to $355 million in 2018 (OANZ, 2018), with an increase of 42% since 2015. When the domestic trade, worth $245 million, is included, the total New Zealand organic sector is worth $600 million, which is an increase of 30% since 2015. OANZ (2018) reports that the organic market is growing almost twice as fast as the non-organic market (8.1% and 4.8% per year, respectively). Fairweather's (1999) prediction in the late 1990s that there was "considerable potential for the continued development of the organic industry in New Zealand" (p.62) appears to have been justified.

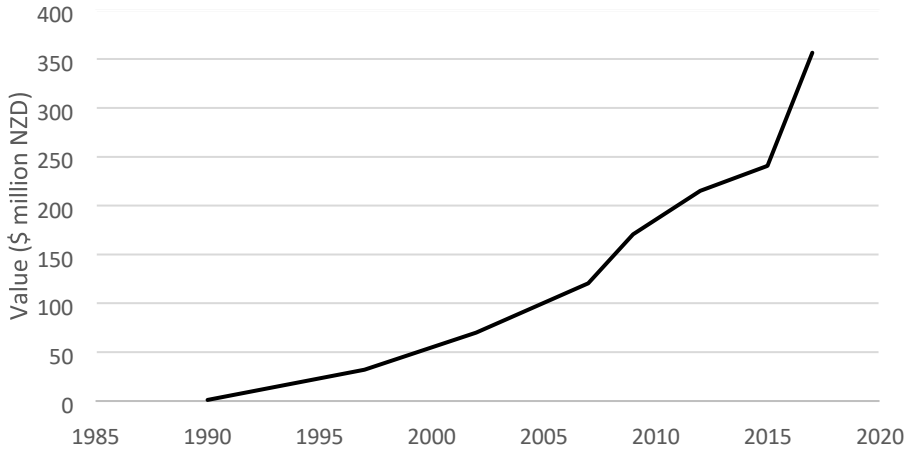

Figure 4. Export value of the New Zealand organic industry 1990-2017 (data from OANZ (2012, 2016, 2018)).

Figure 5 shows the increase in export value of organic dairy, meat and wool in New Zealand. In 2007, organic dairy exports were worth below $7 million, but, ten years later, organic dairy, meat and wool were worth almost $100 million (OANZ, 2018). From being a very small part of the organic export market in 2007, dairy, meat, and wool accounted for almost 30% in 2015 and 2017, and comprise the second-largest organic export category after organic fresh fruit and vegetables in New Zealand. The value of organic dairy, meat, and wool exports has increased by approximately 45% since 2015. The numbers in Figure 5 do not include domestic production, which suggests that the value of the organic dairy industry is greater still, given that there are several smaller operators that only supply the local market.

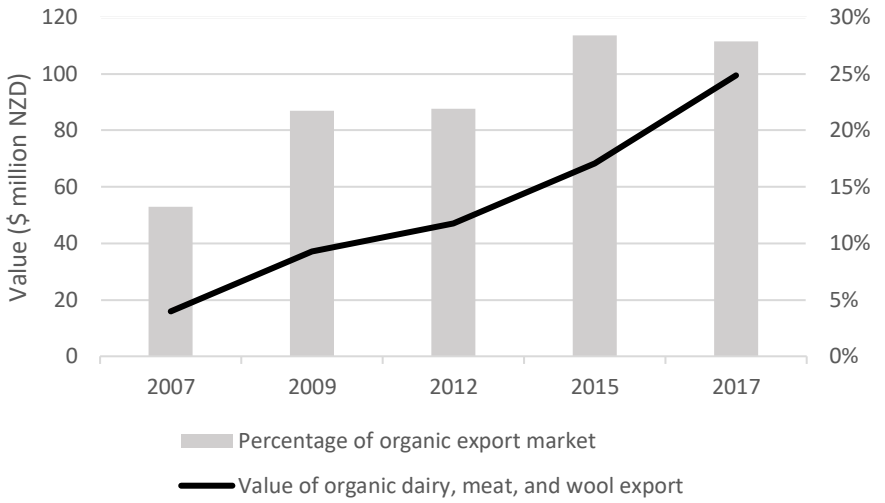

Figure 5. Export value of organic dairy, meat, and wool, and the percentage of the total organic market share held by dairy, meat, and wool, 2007-2017 (data from OANZ, 2018).

In 2015, only 2.5% of all the milk sold in New Zealand was organic (OANZ, 2016), which suggests that significant potential exists for this market to expand. The OANZ market report (2018) forecasts that organic dairy exports will grow rapidly now that 13 New Zealand dairy companies have export capabilities, and that some of them are beginning to develop their organic supply chains. Currently, organic dairy, meat and wool only account for 0.5% of the total dairy, meat and wool exports (OANZ, 2018). The corresponding figure for wine, and fresh fruit and vegetables are 2.8% and 4.7%, respectively.

2.3.2 Options from dairy companies

To understand the processing and value-add options that dairy farmers are offered in Aotearoa New Zealand, it is important to give a brief introduction to the available dairy companies. The Dairy Industry Restructuring Act (DIRA) of 2001 authorised the creation of the dairy company Fonterra through the merger of New Zealand's two largest dairy companies, Kiwi Co-operative Dairies and New Zealand Dairy Group (DCANZ, 2019; Fonterra, 2019). In 2010, it was the fifth-largest dairy company in the world processing 19 billion litres of raw milk, of which 15 billion were sourced in New Zealand (Gray & Le Heron, 2010). In the financial year of 2018, Fonterra processed over 22 billion litres of milk (Fonterra, 2018b). How much of this volume was sourced offshore is unclear from their annual report.

Fonterra is currently obliged under DIRA (2001) to buy milk from any farmer regardless of where that farmer is located. This is known as the Open Entry provision and, although it was put in place as a restraint on Fonterra's near-monopoly status, it has been criticised because Fonterra cannot set enforceable environmental standards to which their suppliers have to adhere (Frykberg, 2019). Those who supply Fonterra are also allowed to be partly independent or supply another dairy

company through the 20% rule set out by DIRA (2001). This rule sets out that shareholding farmers can supply up to 20% of their weekly production to independent processors. This rule came into place when Fonterra was formed, as it then collected 96% of all milk in New Zealand (MPI, 2019a). DIRA has been under review since 2017, and the revised Bill is currently being drafted (MPI, 2019b). Part of the proposed changes includes the right of Fonterra to refuse dairy farmers to become shareholders and supply milk to the company (Kissun, 2020; New Zealand Government, 2019).

The second-largest dairy company in New Zealand is Open Country Dairy, which was also formed in 2001. It has three manufacturing sites (one in the South Island and two in the North Island) and processes around 900 million litres of milk supplied by about 500 farmers (DCANZ, 2019).

Synlait processes around 700 million litres of milk every year (Synlait, 2019c) with a focus on nutritional milk products such as infant formula. About 200 farmers supply Synlait, whose Canterbury processing plant came into production in 2008. Synlait bought the New Zealand Dairy Company in 2017 and has commissioned a second processing plant in Auckland. Furthermore, they have acquired land in Waikato in the North Island to build an additional nutritional powders manufacturing facility (Synlait, 2019a). Synlait is partly owned by a Chinese company (Bright Dairy & Food Co), which acquired 51% of the shares in 2010 (Wood, 2010).

Westland Milk Products is New Zealand's second-largest cooperative supplied by 400 farmers on the West Coast and in Canterbury. It was founded in 1937 and is thus New Zealand's oldest still existing cooperative, as it regained its independence after DIRA in 2001 (Westland Milk Products, 2019a). In July 2019, the shareholders of the company voted to sell all shares to Chinese company Inner Mongolia Yili Industrial Group to ensure a competitive milk price for the shareholders (Westland Milk Products, 2019b).

There are also several smaller dairy companies in New Zealand. Miraka (owned principally by Māori trusts and incorporations Wairarapa Moana Incorporation, Tuaropaki Trust, Waipapa 9 Trust, Hauhungaroa Partnership, Tauhara Moana Trust and Huiarau Farms) is supplied by farmers near Taupo in the North Island (Miraka, 2019). Oceania Dairy (also owned by Chinese company Inner Mongolia Yili Industrial Group like Westland Milk Products) is locally supplied near Glenavy in the South Island (Oceania Dairy, 2019). Tatua processes more than 200 million litres of milk each year and is a cooperative owned and supplied by 107 farmers in the region around Tatuanui in the North Island (Tatua, 2019). There is also the Organic Dairy Hub in the North Island who only source organically certified milk (Organic Dairy Hub, 2019).

From commanding 96% of the market share when it was formed in 2001 (MPI, 2019a), to 93% in 2010 (Gray & Le Heron, 2010), Fonterra processed about 82% in 2018 (TDB Advisory, 2019). The

reason for this is the growth of the other dairy companies claiming market shares. Figure 6 shows how financial and economic advisory company TDB Advisory (2019) expects the smaller companies to grow assuming there will be no growth in milk volume until 2021. Open Country Dairy, Synlait and Oceania are forecasted to increase their market share at the expense of Fonterra, which is forecasted to decrease in market share to 75% by 2021 (TDB Advisory, 2019).

Figure 6. Forecasted milk collection volumes for six of the smaller dairy companies, 2018-2021 (from TDB Advisory, 2019; OCD stands for Open Country Dairy).

In 2016, Fonterra reported that many more farmers were considering becoming organic suppliers, but that they wanted to "manage the growth, we don't want it to go wild" (Hutching, 2016). Currently, however, Fonterra is one of the main suppliers of organic milk along with Open Country Dairy, Organic Dairy Hub (incorporated in 2015), and Marphona Farms (operates Green Valley Dairies) (OANZ, 2018). These companies currently offer an organic premium to varying degrees; Fonterra does not offer the premium everywhere meaning that Fonterra farmers in some areas of New Zealand do not have any external monetary incentive to produce organic milk. No dairy company is currently offering a premium for milk produced in a biodynamic, biological, or regenerative way.

A2 milk is another value-add option that is gaining increased traction. A2 milk is different from 'normal' milk in that it only contains the A2 variant of beta-casein protein (Woodford, 2007). A1 variant of beta-casein protein surfaced in Holstein cows around 8 000 years ago as a result of a spontaneous gene mutation (Pasin, 2017; Woodford, 2007). Before this, all bovine animals were naturally A2. Due to human breeding of cows, especially using the Holstein breed, the A1 variant

has become dominant (Pasin, 2017). Although it is contested by opponents of A2 milk, the product is suggested to be a healthier option as there is scientific evidence that the consumption of A1 milk is related to human diseases such as diabetes, autism, leaky gut, and schizophrenia (Woodford, 2007). A2 milk needs to be sourced from cows that have the genetic makeup of A2/A2. Human, sheep and goat milk are all naturally A2/A2 (Pasin, 2017). For a long time, only the A2 Corporation (now called the A2 Milk Company) in New Zealand marketed A2 milk. In 2018, the A2 milk company entered into a strategic partnership with Fonterra to offer this value-add option to its suppliers and customers (Fonterra, 2018a). The Organic Dairy Hub is also marketing a new A2 milk product (Organic Dairy Hub, 2019), and Synlait appears to be launching a similar product, called A1 protein-free (Synlait, 2019c).

Synlait has been leading the way in terms of offering its suppliers options to add value to their milk. Aside from the new A1 protein-free option, Synlait also offers premiums for grass-fed and for best management practices (Lead With Pride programme) (Synlait, 2019b). Farmers who participate in the former are only allowed to feed their cows on pasture or silage without supplementary feeding, such as grain or palm kernel extract. Farmers who participate in the latter get rewarded for achieving best management practices on farm in regard to environmental performance, animal welfare, and being a good employer (Synlait, 2019b).

Aside from supplying a dairy company to produce pasteurised milk powder for export, some farmers are producing raw milk for the domestic and local market. In 2019, there were 23 dairy farm operators registered with MPI for the sale of raw milk (MPI, 2019d). On 1 March 2016, Raw Milk for Sale to Consumers Regulations 2015 came into effect, which eliminated the use of collection points for selling raw milk. Under the current regulations, raw milk can only be sold at the farm gate or delivered straight to consumers' properties (MPI, 2019c). The new rules thus reduce the ability of urban people to purchase raw milk as they will have to travel further to purchase the milk, and imposes additional costs to the farmer should they decide to do home deliveries. Producers of raw milk reported that the new regulations could essentially put them out of business (Cowie, 2015).

The most notable way that each of the smaller dairy companies profile themselves is to offer different value-add options in order to attract and retain suppliers that previously supplied Fonterra. Although 45% of Fonterra's milk went into producing value-add products in 2018 (Fonterra, 2018b), their suppliers have little direct say in how the cooperative invests and what value-add options it produces. The value-add options that dairy farmers can individually choose from is largely determined by where they live and which dairy companies are able to pick up their milk. The growing importance of smaller companies other than Fonterra is likely to increase

competition between the companies, which could lead to additional value-add options being marketed in the future. Farmers would thus be able to choose from a wider variety of options if they were unhappy with their current supplier or were looking for opportunities to earn an additional premium for their milk. Even without options supplied by dairy companies, some farmers might decide to become independent and sell their own value-add products directly to the consumer.

2.4 Summary

There are different sources of stress related to economic, social and environmental factors that can present a threat or opportunity to a farmer's current farming system. Financial considerations are, of course, paramount since the survival of the business relies on profitability. Lack of profitability can lead to increased stress and negative effects on wellbeing. Stress can also be induced by poor animal health or little time spent with family and children, which could act as drivers to adopt different practices. Similarly, environmental pressures such as climate change and extreme weather events along with environmental regulation could create a motivation to change. As Hill (1998) and Pretty et al. (2018) have described, farmers may tweak their current system through improving efficiencies, substituting one practice for another, or completely redesign their system in response to such pressures. In order for change to occur, however, motivation to perform the changes is essential.

Agroecological approaches, such as biodynamic, organic, biological and regenerative practices, are options that may be seen as alternatives to conventional production. The agroecological production systems have similarities in how they strive to avoid environmental harm by integrating and utilising ecological processes in favour of synthetic chemical applications and other conventional practices. All systems can be placed on a spectrum from less agroecological to more agroecological acknowledging the diversity that exists within each system and how they may overlap.

Most New Zealand dairy farmers operate conventional production systems, but biological, regenerative, organic, and biodynamic production systems are increasingly being adopted. Market reports show an increasing trend of organic consumption both in New Zealand and abroad which bodes well for those farmers who have adopted such production systems. Other than premiums for organic milk products, some dairy companies are offering premiums such as A2 and grass-fed milk. Although financial incentives is just one factor that may influence behaviour, some farmers may be incentivised to change dairy processor or to change practices so that they can supply those products.

The response that dairy farmers choose is likely based on the perception of these threats and opportunities set in relation to their own personal context. The intra- and interpersonal factors, which may influence the choice of practices and production system, will be presented in the next chapter.

3 Literature review on behaviour change relevant to farmers

The majority of the challenges outlined in Chapter 2 are creating pressure towards more pro-environmental behaviour: regulation is increasingly restricting natural resource use; societal transformation is needed to avert adverse effects of climate change; and increasing public endorsement of environmentally and ethically produced foods have opened up niche markets like organic and grass-fed only production. It is for this reason that the majority of the literature review in this chapter focuses on environmental psychology theories that explain pro-environmental behaviour.

Many of the challenges discussed could be perceived as sources of stress and potential threats to farmers' way of operating their businesses. How farmers perceive and cope with these types of stresses and respond to the challenges is the overall aim of this study. It is therefore appropriate to investigate this with the help of a theoretical model that includes such processes. The Protection Motivation Theory (PMT) was chosen as a theoretical starting point for analysis as it focuses on threat and coping appraisal in order to explain how people protect themselves in the face of a threat. It is based on four cognitive processes: perceived severity of the threatening event; perceived probability of the occurrence (or vulnerability); the efficacy of the recommended preventive behaviour; and perceived self-efficacy (Maddux & Rogers, 1983; Rogers, 1975, 1983). These processes will be described in the first part of this chapter.

The second part of this chapter will discuss factors that may be of importance to the decision-making process of farmers when changing practices or production system. Environmental and intrapersonal sources of information are identified as important components that affect coping and threat appraisal of the PMT, but are not described in much detail (Rogers, 1983). Verbal persuasion, observational learning, personality variables, and prior experience are given as examples, but Rogers (1983) states that any source of information could have an influence on the decision-making process. Factors from other models are thus discussed as potential additions to the PMT.

Factors that, through literature review, are expected to have an influence on decision-making will be blended with the PMT in a conceptual framework, which is presented at the end of this chapter. This conceptual framework will act as an analytical tool to help highlight the role of particular factors and processes on decisions made by dairy farmers when considering a change of practices or production systems in response to stress.

3.1 Protection Motivation Theory: a theoretical starting point

The PMT originated in order to explain the effect of fear appeals on human health behaviour. It was used to show how the effectiveness of the response or increase in the level of fear led to acceptance of the proposed adaptive intention or behaviour (Floyd, Prentice-Dunn, & Rogers, 2000). The PMT was originally based on three cognitive processes: perceived severity of the threatening event; perceived probability of the occurrence (or vulnerability); and the efficacy of the recommended preventive behaviour (Rogers, 1975). Maddux and Rogers (1983) and Rogers (1983) later incorporated a fourth process, perceived self-efficacy, into the model to explain the influence an individual's own coping expectations has on the response to the threat. Their study found that self-efficacy was the most powerful predictor of behavioural intentions. Taking a farming perspective, Figure 7 shows how threat appraisal (evaluation of maladaptive response) consists of the intrinsic and extrinsic rewards of maintaining the current farming system minus the severity of the perceived threat and the vulnerability of the farm business to the threat. Once a threat has been perceived, evaluation of how to cope with or avert the threat begins (Floyd et al., 2000). Coping appraisal consists of the efficacy of the alternative practice and the confidence a farmer has in implementing it minus the costs of implementation. The four main processes are thus evaluated by the individual in light of the perceived rewards of maladaptive behaviour and perceived costs of adaptive behaviour (Floyd et al., 2000). Taken together, these determine the motivation and, hence, the intention to behave in a certain way to counter the perceived threat, which Maddux and Rogers (1983) describe as the 'outcome expectancy for an alternative behaviour'. The motivation whether to act is theorised to be the result of the perception that there is a relative advantage in doing so and that the situation will improve with a change in behaviour. The protection motivation response for farmers could be a decision to maintain practices, change practices, or redesign their production system, for instance. As the response to perceived threats is likely to differ from person to person because each farmer and each farm context is different, it is important to approach a number of farmers to see if there are any overarching similarities or differences in their decision-making process.

Figure 7. Protection Motivation Theory explains how individuals behave in response to the threat's perceived severity and vulnerability and how well they perceive they are able to respond (adapted from Floyd, Prentice-Dunn, & Rogers, 2000).

Contrary to suggestions of the original model, Maddux & Rogers (1983) found that only two of three components (probability of occurrence, coping response efficacy, and self-efficacy) need to be perceived as high for high levels of intention to form. For instance, if the threat level is perceived to be low, the behaviour might still be expressed if the strategy to avoid the threat is effective, and the behaviour is easy to do. Conversely, if the threat level is perceived to be high, but the strategy to avoid it is not very effective, an individual might still express the behaviour if it is easy to do. An individual in the former scenario might think that they have nothing to lose by adopting the behaviour and so take precautionary measures (termed precaution strategy). An individual in the latter scenario feels threatened and wants to do anything they can to protect themselves (either to reduce anxiety or to avoid danger) even if it might not be that effective (termed hyperdefensiveness strategy) (Maddux & Rogers, 1983). The strategies are, therefore, not entirely 'rational' in the traditional sense but offer a way to support an individual's perception of their own safety and wellbeing. These strategies are also reasonable responses that farmers could make when addressing perceived threats. For instance, a dairy farmer might adopt a recommended practice that is deemed effective and easy to do, even if they do not agree with the reason why. Conversely, a farmer might be extremely concerned about changing consumer trends and might, in response, change to supplying grass-fed only milk even if the transition is perceived to be difficult. Using the PMT as a foundation of analysis allows us to investigate strategies used by farmers in response to stresses, thereby shedding light on their decision-making process.

A meta-analysis of responses to health-related threats conducted by Floyd et al. (2000) showed that coping variables were, in general, increasingly important as considered changes became greater. For instance, quitting smoking required high levels of response efficacy, self-efficacy and low response costs, whereas starting to exercise required less response efficacy and self-efficacy and could tolerate higher response costs. For maintaining healthy eating practices, high levels of self-efficacy were required but could tolerate lower levels of response efficacy and higher response

costs. Threat variables, on the other hand, were found to be equally effective for all kinds of changes considered (Floyd et al., 2000). That there are measurable differences in the effect of both threat and coping variables depending on the degree of change is useful for this study, which will be looking at reasons behind different kinds of changes: maintaining the current system, improving efficiencies, substituting practices, and redesigning the production system. This presents yet another reason why the PMT is an appropriate theoretical starting point to address the objectives of this study.

Floyd and colleagues' (2000) meta-analysis also shows that the threat and coping variables differ in strength depending on the health issue at hand and acknowledges the influence of psychosocial factors. This is relevant for this study, as the response to an array of challenges will be investigated that is expected to elicit different responses depending on the individual and the context. As this thesis aims to look at decision-making from the perspective of dairy farmers, it is appropriate to use a model that does not presuppose rationality in the decision-making process. The PMT acknowledges that the threat and coping appraisal is affected by cognitive and motivational biases and that each farmer will perceive threats and ways of coping through their own lens.

The PMT has been used extensively in studies on attitudes, intentions and behaviours in relation to human health, and has also been used to explain a range of different behaviours related to farming. For example, all major PMT variables were found to explain responses to climate change among oil palm farmers in Malaysia (Nabara, Man, Kamarulzaman, & Sulaiman, 2020), climate change response of rice farmers in the Mekong Delta in Vietnam (Le Dang, Li, Nuberg, & Bruwer, 2014), and skin cancer prevention behaviours of farmers in Iran (Babazadeh, Nadrian, Banayejeddi, & Rezapour, 2016). Keshavarz and Karami (2016) used the PMT (with the addition of annual income, social environment and age of the household head as variables) to evaluate farmers' pro-environmental behaviour under drought in arid and semi-arid regions in Iran. They found that response efficacy was the variable showing most positive influence on the decision to adopt conservation practices. The study also showed a negative relationship to perceived severity of the threat, indicating that the higher the perceived severity, the less chance there was of adopting conservation practices. With this study, Keshavarz and Karami (2016) showed that the PMT is a useful model for slow-onset risks, which gives support for using the PMT in this study because the challenges discussed can be both slow-onset (chronic) and rapid-onset (acute).

The PMT has been criticised for not accounting for the influence of others' behaviour and for ignoring the context in which the decision takes place (Schwarzer, 2016). To counter the lack of social and environmental factors, many studies (e.g. Babazadeh et al., 2016; Keshavarz & Karami,

2016; Le Dang et al., 2014; Nabara et al., 2020) have included additions to the PMT model. For instance, Le Dang et al. (2014) showed that income, getting information from trusted sources, and belief in climate change were particularly important for farmers' coping appraisal. This shows the importance of including additional factors that may have an influence on coping and threat appraisal in this study. The authors also explain how the list of factors may differ depending on the context, which gives further support for including a range of factors that may reasonably affect dairy farmers' decision-making.

The PMT has also been criticised for not taking the difficulty of overcoming habitual behaviours into account (Schwarzer, 2016). The relevance of including habits in a conceptual framework in relation to farmer decision-making will be discussed in Section 3.2.1.

3.2 Additional factors affecting farmer decision-making

This section describes factors that have been found, through literature review, to affect decision-making. Some of them (personality variables, prior experience, observational learning, and verbal persuasion that are described as environmental and intrapersonal sources of information proposed to affect threat and coping appraisal (Floyd et al., 2000; Rogers, 1983)) are part of the PMT. These and other factors identified from other theories are discussed as appropriate additions to the conceptual framework of analysis for this study.

3.2.1 Facilitating conditions and habits

Existing or potential regulations were discussed, in Chapter 2, as a clear challenge for farmers, which may affect all dairy farmers in Aotearoa New Zealand. How badly farmers are affected by the regulations will, however, depend on their context and which type of farming system they are currently operating. The impact of such regulations will differ from farm business to farm business. Similarly, access to financial support will also differ depending on current levels of debt and ability to loan more money to invest. Thus, context is important at all stages of the decision-making process, both in terms of appraising the threat and the capability to deal with the threat, but also in terms of whether or not the opportunity exists to follow through on the intention. The intention to perform a behaviour does not always equate to actually performing the behaviour (Ajzen, 1991; Klöckner, 2013; Schwarzer, 2016). It is essential to include an exploration of facilitating and constraining conditions in this study, and to choose a methodological approach that allows farmers to freely explain what made it possible for them to change their practices or production system, or hindered them from doing so.

Facilitating conditions could be described as contextual factors that create the opportunity for an individual to move from intention to action (Egmond & Bruel, 2007). Michie, Van Stralen, and West

(2011) echo this sentiment in their study on how to improve the design and implementation of behaviour change interventions. They constructed a behaviour change wheel where the opportunity to perform an activity is as necessary as motivation and capability in order for a change in behaviour to occur. Opportunities or facilitating conditions for farmers could include interventions such as restrictions (reducing the opportunity for behaviours that are undesirable, e.g. through regulations), enablers (reducing barriers or increasing means and incentives, e.g. financial support and premiums), or changing the physical or social context (e.g. access to a different dairy company enabling pickup of A2 milk, or invitation to a discussion group) (Michie et al., 2011).

Two particular conditions that may be especially important for farmers as facilitating conditions are location and financial capacity. Location is part of a farm's characteristics together with size, industry type, farming intensity, and land-use capability (Small et al., 2015). Depending on the location in Aotearoa New Zealand, a farm might receive sufficient rainfall, whereas others might have to rely on extensive irrigation. Other characteristics that will differ depending on location are soil type, aspect of the land and proximity to processing plants for milk. Yang and Sharp (2017) found that the closer dairy farmers were located to a water body, the more likely they were to adopt practices that reduced the impact on the waterways such as riparian planting and fencing. Location is hence an important contextual factor that might limit the possibility of changing practices or production system.

Financial capacity is another important determinant when deciding to change behaviour (Small et al., 2015). It has been found that adoption of environmentally friendly farming practices on farms in Aotearoa New Zealand is heavily constrained by financial capacity (Nuthall, 2010; Rauniyar & Parker, 1998). Yang and Sharp (2017) found that dairy farmers with financial difficulties were 46.5% less likely to adopt best management practices of water quality management than dairy farmers who had no financial difficulties. Financial problems were followed by lack of information and personal reasons as the main barriers to adoption of best management practices in Aotearoa New Zealand. If changing practices or production system is perceived to involve significant investment in terms of purchasing more land or new technology, hiring more staff, or foregoing income for a few years, smaller farms might experience greater barriers to change than larger farms due to the amount of profit a farm generates (Barr, 2011). Banks tend to treat farms as 'high risk' meaning farmers can be exposed to higher interest rates, which ultimately suggests that taking risks is only possible if they can afford the financial consequences of failure (Vanclay, 2011). As alluded to in Section 2.1.7, banks were willing to loan dairy farmers in Aotearoa New Zealand money when the milk price was high, and the outlook and future of the industry were positive. If the future is

perceived to be bleak, however, banks are able to refuse farmers larger loans, which can have a major impact on farmers' ability to invest or even stay financially viable as a business.

The PMT does not describe the step from protection motivation (precursor to intention) to coping modes (behaviour) as a cognitive mediating process, but is described rather as something that directly translates into either adaptive or maladaptive coping (Figure 7). As intentions do not translate into behaviour by default, it is important to look at models that explore this process deeper. The Theory of Interpersonal Behaviour (TIB), proposed by Harry Triandis (1977), includes habits (frequency of past behaviour) and facilitating conditions as moderating factors of intention that may enable or constrain behaviour (Egmond & Bruel, 2007) (Figure 8). Similar to the PMT, the TIB has been criticised for not taking contextual and psychological factors into account, which have led to the model being modified or joined with other models when attempting to explain farmer adoption of sustainable agricultural practices (Tey et al., 2014).

Figure 8. The Theory of Interpersonal Behaviour includes the factors habit and facilitating conditions as moderators of intention (from Egmond & Bruel, 2007).

Kalule, Sseguya, Ongeng, and Karubanga (2019) investigated the influence of faculty supervision support of students while the students were on placement on farms as enablers of farmer learning. It was found that there was a significant relationship between farmers' perceived value of learning content and farmers' perceived quality of students' attitudes, which in turn had a significant relationship to faculty supervision support. Interestingly, the researchers found no direct relationship between faculty supervision support and the farmers' perception of the value of learning content. The study thus showed how faculty supervision support acts as a facilitating condition in the formation of intention and behaviour. As described previously, facilitating conditions such as financial capability and location may not directly influence the motivation to act

but rather enables or constrains it. Hence, this factor is placed as a moderating variable of behaviour in the conceptual framework.

Following the definition of Camic (1986), Dietz and Stern (1995) define habits as "nearly automatic, unconsidered behaviours" (p.262) although they clarify that most human behaviour is neither habitual nor fully deliberated. Habits are learned and recurring behaviours that individuals perform with little to no active decision-making (Neal, Wood, Labrecque, & Lally, 2012; Wood & Rünger, 2016). Examples could include nail biting, skipping breakfast, and going for a daily run after work. Even though the behaviours are habitual, individuals will be able to rationalise their decisions by referring to their values, preferences, and goals as these have at least been considered in the past at some point (Dietz & Stern, 1995). In this way, behaviour that develops into a habit could have been a product of a calculated decision.

Habits have been criticized for only serving as temporal stability and not being as good as other constructs (e.g. attitude towards a behaviour) at explaining the link between past and future behaviour (Quellete & Wood, 1998). This is contested by Klöckner (2013), who states that other models such as the Value-Belief-Norm Theory (VBN) and Theory of Planned Behaviour (TPB) perform poorly for repeated behaviours as these do not take habits into account. Quellete and Wood (1998) found in a meta-analysis that habits that were performed annually or biannually had little influence on intention translating into behaviour. Habits that were performed daily or weekly, however, had a strong influence. How likely it is that a behaviour changes seems, therefore, to depend on habit strength (at what frequency the previous behaviour was performed) and whether it could be considered a habit.

Rhodes, Casey, Payne, and Brown (2016) assert that overcoming habits are a key challenge for farmers in Aotearoa New Zealand when changing behaviour and that they can be hard to identify. The effect of habits on dairy farmers' intention to change practices or production system is likely to be different depending on whether the decision is simple or complex. Changing a simple behaviour that is performed often, such as fertilising the pastures the day after the cows have been in there, can be hard to overcome as the new behaviour can be easy to forget or to ignore. A complex decision such as changing production system, however, does not happen often and is likely to have involved a significant amount of consideration before making the decision. In cases such as these, habitual behaviour can be easier to overcome. In this study, it is expected that habits have a greater impact on simpler decisions such as improving efficiencies than on system redesigns. Habits are thus included in the conceptual framework as a moderating factor of behaviour prior to the influence of facilitating conditions.

3.2.2 Perceived behavioural control

Being able to cope effectively with changes is an essential element to include when looking at the decision-making process of farmers responding to stresses and challenges. Perceiving that there is a threat to one's farm business such as changing consumer trends, but feeling incapable of doing anything about it is bound to increase stress levels even further and is not likely to lead to changes in behaviour. For this reason, the PMT includes self-efficacy as a central component, which refers to a person's operative capability and "the belief in what one can do with whatever resources one can muster" (Bandura, 2007, p. 646). It is related to feelings of control and self-confidence, and is subtly different to a similar concept, perceived behavioural control, which "refers to people's perception of the ease or difficulty of performing the behaviour of interest" (Ajzen, 1991, p. 183).

Perceived behavioural control is a cornerstone of the Theory of Planned Behaviour (TPB) (Figure 9), which was developed from Ajzen & Fishbein's (1980) Theory of Reasoned Action (Ajzen, 1991). The basis for the TPB is that a person's intention to behave a certain way is carefully reasoned based on attitude towards the behaviour, subjective norms, and perceived behavioural control (Ajzen, 1991). In his meta-analysis, Klöckner (2013) found that perceived behavioural control was the third strongest predictor of behaviour after intentions and habits.

Hijbeek et al. (2018) studied the practice of increasing soil organic matter among Dutch farmers and found that the influence of perceived behavioural control varied for different variables depending on farm intensity. High-intensity farms were more positive about increasing soil organic matter whereas medium-intensity farms were more worried about costs of organic material. Low-intensity farms were more positive about the use of specialised crops to increase soil organic matter. Overall, however, perceived behavioural control was equally influential on intention and decision to act regardless of intensity of the farm. This highlights the importance of this concept. Klöckner (2013) asserts that perceived behavioural control can interrupt values leading to behaviour, which is something that other models such as the Value-Belief-Norm (VBN) theory would not be able to detect.

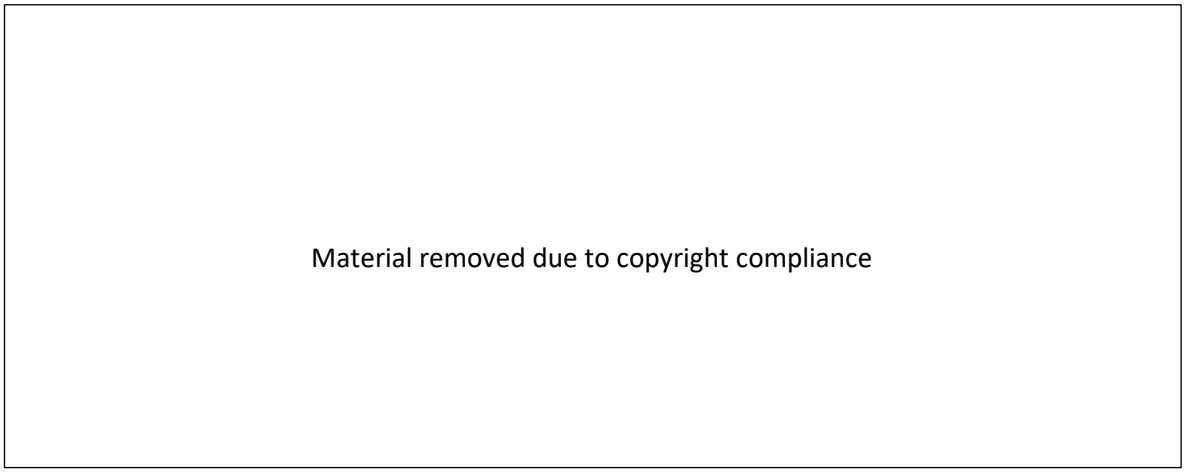

Figure 9. In the Theory of Planned Behaviour, the interaction of attitudes, subjective norms and perceived behavioural control shape people's intention to act, which could lead to expressed behaviour (from Ajzen, 1991).

Conner and Armitage (1998) described several studies investigating the theoretical distinction between perceived behavioural control and self-efficacy. Perceived behavioural control relates more to whether or not an outcome can be influenced by a person's own actions, whereas self-efficacy relates more to the confidence people have in their ability to perform the behaviour. Manstead and van Eekelen (1998) conducted a study of students' past and future academic achievements to disentangle the two concepts and found that self-efficacy was more positively related to intentions and behaviour than perceived behavioural control, although both results were significant. Similar results were also found in a study on exercising and healthy eating (Parkinson, David, & Rundle-Thiele, 2017). In a similar vein to Terry and O'Leary (1995), Parkinson et al. (2017) argue that self-efficacy primarily reflects internal drivers of behaviour and control factors, whereas perceived behavioural control reflects external drivers or barriers to behaviour change.

Although Terry and O'Leary (1995) found, in their study on intention to exercise and actual exercise behaviour, that the two concepts can be empirically distinguished (Manstead & van Eekelen, 1998), both internal and external drivers are likely to exert influence on farmers' decision-making process. These factors also likely interact in a way that may make it difficult to disentangle in an interview scenario with farmers. For example, having the ability and full control to change a dairy system from twice a day milking to once-a-day milking (perceived behavioural control) likely interacts with the feeling of confidence in making the change (self-efficacy) which ultimately may lead to the change actually taking place.

Perceived behavioural control and self-efficacy are connected to the concept of facilitating conditions. An incentive in the form of a premium to produce organic milk for instance might be necessary for the farmer to feel that it is easier to transition (perceived behavioural control) or influence the farmer's confidence to cope with the transition (self-efficacy). That same premium

might also enable a farmer to act on their already existing motivation to change due to the financial capability provided (facilitating condition). The fluidity of the concepts are also highlighted by the design of the TPB where perceived behavioural control is said to both have an influence on the creation of intention but also directly on behaviour (Ajzen, 1991). Due to the influence that these three concepts can have on farmers' decision to change practices or production system, it is essential to include them all as factors influencing behaviour in the conceptual framework.

Perceived behavioural control will be included as a factor to explore alongside self-efficacy because of their similarity in concept affecting the intention to act but also due to its potential as a moderating factor of behaviour similar to facilitating conditions. Perceived behavioural control is placed together with self-efficacy in the conceptual framework to more closely mirror Ajzen's (1991) description of perceived behavioural control. Scholars disagree, however, on where it has most influence; Terry and O'Leary (1995) found (contrary to Manstead and van Eekelen (1998) and Parkinson et al. (2017)) that perceived behavioural control had no influence on intention but it did on actual behaviour, and that self-efficacy had no influence on actual behaviour but it did on intention.

3.2.3 External knowledge

Historically, agricultural extension programmes mostly focussed on the transfer of knowledge to bring about change and influence behaviour (Vanclay, 2011). The assumption was that the more an individual knew about an issue and how to change it, the better they would be able to evaluate the potential outcomes, and, thus, be more likely to adopt new practices. This approach, however, diminished the importance of value orientation (Vanclay, 2011) and context (Wilkinson, 2011), as well as other intrapersonal factors that influence human behaviour (Kollmuss & Agyeman, 2002; Rhodes et al., 2016). Furthermore, Steg and Vlek (2009) explain, in their study on adoption of electric vehicles in the Netherlands, that convenience also has a large part to play in the adoption of practices. If the new behaviour does not constrain other behaviours, takes little time and effort to do, and is not subject to societal disapproval, knowledge transfer as a method of influencing behaviour can be effective. This might be true in New Zealand farming systems today, as well, if a practice change is convenient and easy to do. Improving efficiencies with the use of inputs, such as fertiliser and irrigation, is comparatively easy to do in contrast to improving management of pasture and livestock. The former is suggested to be examples of gains that can be easily achieved and simple to incorporate into a farming system. The latter is an example that requires an increased skillset and confidence to perform that is harder to achieve through a simple transfer of knowledge to the farmer (Rhodes et al., 2016).

Farmers receive information from a variety of sources (e.g. sales representatives, educational institutions, industry bodies, neighbours, social media, magazines), but the source of information is likely to have an influence on whether the information is deemed trustworthy or not. In their study of 1767 private forestry owners in the United States of America, Sagor and Becker (2014) showed that the owners valued receiving information from many different sources despite their networks being relatively small. Participants valued and trusted information received from a peer (65%) more than from professional foresters (53%). Small et al. (2015) show similar findings in Aotearoa New Zealand: primary producers tend to have small networks, and trust veterinarians and other farmers more than financial advisors and scientists. Government advice was trusted the least. This highlights how intrapersonal factors interact with information acquisition.

In the PMT, environmental and intrapersonal sources of information initiate the threat and coping appraisal. Verbal persuasion and observational learning are grouped into environmental sources of information, and personality variables and prior experience are grouped into intrapersonal sources of information. Rogers (1983) does not state that these groups are mutually exclusive but states that "any source of information can lead to any of the mediating processes" (p. 167). My interpretation of this is that these can interact and be of different strengths depending on the situation at hand. Therefore, this grouping has been eliminated in the conceptual framework. The term 'sources of information' is also confusing as it may lead the reader to assume that only strictly sources of knowledge are included, which does not seem to be the original intent. To include all the factors that may influence threat and coping appraisal, the term has been renamed 'influential factors', The term 'verbal persuasion' is also renamed 'external knowledge' to allow for a more inclusive term that extends beyond verbal forms of persuasion. The new term includes knowledge gained from all kinds of places that the literature review above has highlighted.

3.2.4 Social connectedness and observational learning

Farmer interaction and exchange of information between trusted parties is important when examining decision-making because information acquisition can be a social practice. Yang and Sharp (2017) found in their study on adoption of best management practices of water quality that spatially and socially close dairy farmers show spill-over (or neighbourhood) effects in that they have similar choice preferences. Listening to and learning from one's neighbour reduces the uncertainty of adopting new practices since one is able to receive advice from trusted sources, as has been shown in studies on conversion to organic practices on farm (Läpple & Kelley, 2015; Lewis, Barham, & Robinson, 2011). Social connectedness, observational learning, and whom one trusts, are likely to be important factors that influence what options a farmer considers when faced with a threat.

Damon Centola (2019) describes how adoption diffuses in social networks through simple and complex social contagions. A simple contagion spreads quickly from person to person from one single activated contact, whereas a complex contagion requires multiple sources of exposure. News is an example of a simple contagion, as it is easily propagated through a network. Adoption of new behaviours, however, is more often a complex contagion because the adoption can involve multiple and competing considerations, including such things as financial, psychological, or reputational risks (Centola, 2019). The reason why a complex contagion needs several sources of contagion is because they increase the perceived value, credibility, legitimacy, and emotion attached to the behaviour (Centola, 2019). For instance, a farmer might not be keen on going organic but may feel differently about it if several of other farmers in their network adopt it. An individual's expectation that others will approve of the proposed behaviour, and that others are also considering it, thus increases the probability that they will adopt it. This is a way of mitigating risk and feeling confident when contemplating high-cost complex decisions, which is related to increased levels of perceived self-efficacy (Floyd et al., 2000).

Human behaviour is affected by connectedness (Barnes, Lynham, Kalberg, & Leung, 2016; Granovetter, 1978) and by what society thinks of the behaviour (Ajzen, 1991, 2005; Centola, 2019). In a strongly connected society, ideas, knowledge and experience can be freely exchanged and influence behaviour in other parts of the social network (Barnes et al., 2016). There are many examples in the literature (e.g. Caniëls & Romijn, 2008; Sagor & Becker, 2014; Yang & Sharp, 2017) where the sharing of information, and looking 'over the hedge' at what the neighbour is doing, enables diffusion of new sustainable technology and the adoption of new practices. Strong ties between individuals will facilitate the adoption of new behaviours and help the diffusion of complex contagions (Centola, 2019).

Individuals care about how other people see them and how they see themselves as members belonging to a group, which can be an important source of pride and self-esteem (Islam, 2014). Belonging to a group has a tendency to bias individuals into believing that their group (the 'in-group') is superior and has more positive qualities than other groups (the 'out-group') (Islam, 2014; Tajfel & Turner, 2004). Failing at something could have a significantly negative impact on an individual's sense of self-esteem and how they are perceived by their 'in-group'. This might make an individual think twice about whether or not to try something new where the risk of potential failure is high (Barr, 2011). The status among peers of being a "good farmer" can be a reputation built up over generations and is likely to influence whether change of practices would occur if this reputation were to be threatened (Burton & Paragahawewa, 2011). This is related to social norms, which will be discussed further in Section 3.2.7.

Centola (2019) highlights the importance of reinforcing a message by having many voices connect via so-called bridges. In this way, belonging to national farming groups that meet up a few times per year may have a positive impact on diffusion as those connections may be reinforced and the ties strengthened between the 'in- and outgroup'. Asking farmers about who their supporters are/were and whether anyone specifically influenced their decision to change practices or production system is, therefore, an essential question to include in this study. Observational learning (already a part of the PMT's environmental source of information; see Figure 7) and social connectedness need to be considered as factors in the conceptual framework to adequately capture the interactions between farmers and the knowledge and skills they possess, and how that affects threat and coping appraisal.

3.2.5 Prior experience and personality variables

As part of a broader study of six case study farms, Kalaugher, Clark, Small, Glyde, and Bornman (2016) interviewed nine experienced farmers in Aotearoa New Zealand on their perspectives on adaptation to climate change impacts. The researchers suggest that experienced farmers (average of 20+ years of dairy farming experience each) have adaptive strategies for dealing with risks associated with climate change and extreme weather. These strategies include not stretching the system to its limits (buffering), ensuring the farm system is diverse and flexible enough to cope with variability, careful planning and building social capital. As this example suggests, increased age and/or experience can improve the adaptive capability of an individual and make them perceive a lower level of threat from issues such as environmental regulation or climate change impacts. The level of risk one might accept before acting might thus change with time and experience. It must be kept in mind, however, that this study had a very limited sample and the results are hence only indicative.

The strength of an individual's personality variables or traits can have a significant influence on risk-taking and changing behaviour. A study by Weller and Tikir (2011) shows that risk-taking is not a stable individual variable but changes depending on the domain in which the risk is being taken. Hence, the context in which the risk is taken makes a difference as well as the perceived risks and benefits from engaging in an activity (Weller & Tikir, 2011). In a meta-analysis on the adoption of pro-environmental attitudes and behaviours, Soutter, Bates, and Mõttus (2020) showed strong correlations to openness and honesty-humility followed by agreeableness, conscientiousness and extraversion. They also showed that age, gender and country of origin act as moderating factors. The importance of openness on adoption of pro-environmental behaviours is related to the positive correlation of that factor to cognitive ability and being informed. This could increase the level of awareness of impacts on the environment suggesting that increased knowledge may lead to

behaviours to counter the threat (Soutter et al., 2020). It has also been shown that individuals who are more anxious (either by personality trait or as an induced state) become more risk-averse when reminded of adverse events such as natural disasters, than those who were not (Vastfjall, Peters, & Slovic, 2008). This also gives credence to the inclusion of external knowledge as an influential factor in the conceptual framework, and further highlights its interaction with intrapersonal factors. For example, a risk-averse farmer, who is not likely to change their system, may, through being given information about an opportunity or seeing it successfully demonstrated on a neighbour's farm, become more likely to try it as their fear of failure decreases. This also ties in with self-efficacy and the confidence farmers can build through external knowledge, observational learning and social connectedness.

Even though personality variables are generally thought to be relatively stable, they can change over time (McCrae & Costa, 1987; Milojev & Sibley, 2014) as they are influenced by learning, perception, motivation and the environment (Eysenck, 1977). In a study by Milojev and Sibley (2014) on New Zealanders in the age group 20 to 80 years old, openness to experience and conscientiousness showed the greatest 'inverted U' pattern, illustrating that individuals in their 50s are more consistently open and conscientious than younger and older individuals. This is slightly at odds with a review conducted by Gruère and Wreford (2017) on barriers to adopting climate-friendly practices in agriculture, which described how older farmers are less open to adopt new technologies or environmentally friendly farming practices when compared to younger farmers. The disparity is likely due to the Gruère and Wreford (2017) study being conducted in a particular domain, whereas the study by Milojev and Sibley (2014) is domain-free. The results from the review conducted by Gruère and Wreford (2017) are similar to those of Kalaugher et al. (2016) indicating that older and more experienced farmers are perhaps less open to change as they have more trust in their system's adaptive capability. This literature shows the importance of taking context into account when considering the role of personality variables and prior experience in decision-making.

3.2.6 Affect

The TIB (Figure 8) includes affective factors (emotion and role beliefs) as influences on the intention to perform an activity. Affect is defined as subjective experienced feelings and has become increasingly important in psychology over the years (Loken, 2006). Feelings of affect influences the intention to perform an activity (Egmond & Bruel, 2007) by making us feel good about doing something (Lindenberg & Steg, 2007; Steg & Vlek, 2009), which may act as a motivator for behaviour. Driving a car, for instance, may have a more symbolic and affective function than the instrumental function of getting from A to B (Steg & Vlek, 2009). Judgement and risk perception are thus influenced by negative and positive affect, which might obstruct or contribute to accurate

appraisal of a situation and by extension the decision to change or maintain behaviour (Blanchette & Richards, 2010). Hinds and Sparks (2008) showed, in their study on people's engagement with the natural environment, that emotional connection to the natural environment was positively associated with pro-environmental behaviour. They had added affect and identity to the TPB in their study as the TPB is often criticised for not taking affect, identity or moral obligation into account (Conner & Armitage, 1998; Egmond & Bruel, 2007; Klöckner, 2013).

For farmers contemplating a change of production system, factors such as how content they are with their current situation and how they evaluate the potential outcomes of a changed system are suggested to have an influence on decision-making. Through interviews with farmers, Mortlock and Hunt (2008) identified beauty and the appearance of the farm to be one of the main factors influencing wellbeing. If a farmer experience more positive levels of affect related to the beauty of their farm, they would be less likely to contemplate making any changes to the farm that would jeopardise such a feeling. Conversely, if a farmer would see their land deteriorating in quality and beauty it could lead to feelings of sadness or anger. If this deterioration could be tied to current management practices, they might feel more inclined to evaluate other management strategies that they perceived have less negative impacts on the land. Similarly, some farmers may be depressed or angry due to regulatory pressures or public perception. These strong emotions can act as great motivators (Bradley & Lang, 2007) that may drive behaviours with respect to adopting recommended practices by the government or industry-good bodies (either accepting or rejecting them). Equally, strong feelings of happiness due to a good calving season, healthy cows, or an increase in the milk price may give some farmers feelings of delight, pride, or contentment, which may influence their decision-making. The examples described above have all concerned aspects that have a direct impact on the farm or the farmer. The will to care and protect something from harm may, however, diminish the further one is emotionally removed from an individual or an object (Chawla, 1999; Yang & Sharp, 2017). An example could be climate change, where it may be difficult to see direct effects on the farm business until much later. This literature shows that it is appropriate to include affect as an influential factor acting on threat and coping appraisal in the conceptual framework.

3.2.7 Values, beliefs and norms

Values, beliefs and norms are the cornerstones of the Value-Belief-Norm (VBN) theory proposed by Stern, Dietz, Abel, Guagnano, and Kalof (1999) and Stern (2000) (Figure 10). The theory was built upon the Norm-Activation Model (NAM) first proposed by Schwartz (1977) to attempt to explain pro-environmental behaviour in relation to altruistic behaviour. Stern et al. (1999) and Stern (2000) suggested the existence of three value orientations that every individual has in different strengths:

biospheric, altruistic, and egoistic. Altruistic values, related to removing sources of harm and suffering from other people, are thought to be especially important for engaging in pro-environmental behaviour (Stern, 2000). Biospheric values are similar to altruistic values, but were described as distinctly based on the willingness to remove sources of harm and suffering in the non-human world, such as endangered species or habitats (Stern, 2000). Egoistic values, on the other hand, may be negatively linked to pro-environmental behaviour, as they relate to removing sources of harm and suffering from oneself rather than from other objects or people. Kollmuss and Agyeman (2002) argue that the egoistic orientation is stronger than the altruistic orientation, which in turn is stronger than the biospheric orientation. Given this, farmers who feel threatened by environmental regulation may be more inclined to change practices because it directly affects them, rather than changing practices because of the impacts of the environment or other people.

The VBN theory suggests that a person's sense of obligation to act will be guided by their values, their awareness of consequences to valued objects, and their beliefs about their ability to reduce the threat to the object (Stern et al., 1999). The perception that their actions will have an effect is crucial, because if people do not believe they can have an impact, they will not behave in a way that protects the valued object. This is similar to concepts present in the PMT and TPB: 'Adverse consequences for valued objects', which is termed 'awareness of consequences (AC) in the VBN, is akin to threat appraisal, and 'Perceived ability to reduce threat', which is termed 'ascription of responsibility' (AR), is akin to self-efficacy of the PMT and perceived behavioural control of the TPB. Inasmuch as the VBN components directly bear on environmental issues, and have been shown to be valid predictors of such behaviour, its components should be given consideration in any research having to do with environmental decision-making regarding farming practices.

Figure 10. The Value-Belief-Norm theory states that biospheric, altruistic and egoistic value orientations shape beliefs, which in turn influence personal norms, which can give rise to different pro-environmental behaviours (from Kurisu, 2015).

The VBN was developed specifically to explain pro-environmental behaviour and has been criticised for being poor at predicting behaviours that entail high cost (in terms of effort, time and money) or that constrains other types of behaviour (Steg & Vlek, 2009). The VBN has, however, been used to evaluate the practice of composting agricultural residues to improve organic matter in soils among Iranian farmers (Rezaei-Moghaddam, Vatankhah, & Ajili, 2020), which can be said to be a high-cost decision as it includes knowledge acquisition to be able to perform the behaviour. The study found support for the VBN in that those with strong moral norms were more likely to adopt the practices. The researchers, however, also found that perceived behavioural control had a significant effect on the financial ability of the farmers to engage in the practice. Those with high financial capability may have felt that it was a low-cost decision, whereas those with low financial means considered it a high-cost decision. The scope of this study covers behaviours that range from low-cost (maintaining current system) to high-cost (redesigning production system), which is an additional reason to explore elements of the VBN theory.

Values

Egoistic, altruistic, and biospheric values can be important for farmers when deciding how to act. Farmers could decide to adopt certain practices for self-enhancement (e.g. personal financial gain; egoism), the wellbeing of others (e.g. a healthier workplace for their employees; altruism), or because of concern about the environment (e.g. a healthier planet; biospherism). Although farmers

value and have a positive attitude towards the environment in general, they are more likely to change their practices when personally faced with environmental degradation (Chawla, 1999; Vanclay, 2011). Values have been described as guiding principles when selecting and evaluating behaviours. Ten motivationally distinct types of values (self-direction, stimulation, hedonism, achievement, power, security, conformity, tradition, benevolence, and universalism) are considered universal but differ in importance between groups and individuals (Schwartz, 2012). What is important to one individual might not be as important to their neighbour, for instance, and thus they may have different goals and form different motivations to act (Jonsson & Nilsson, 2014; Schwartz, 2012). In a study on climate change mitigation and adaptation practices of rice farmers in China, Zhang, Ruiz-Menjivar, Luo, Liang, and Swisher (2020) found that the VBN was better at predicting altruistic behaviour like mitigation, and that the TPB was better at predicting egoistic behaviours like adaptation. It is likely that the participants of this study will exhibit both altruistic and egoistic behaviour, which supports the inclusion of the factors of the VBN into the conceptual framework in addition to perceived behavioural control from the TPB.

Beliefs

Beliefs are subjective ideas that an individual holds about all kinds of objects, events and people, and can vary in how confident an individual is that the beliefs are true (Schwartz, 2012). Beliefs are defined differently in various theories and models. In the VBN, beliefs are defined as being important for environmental values, and how they might be protected through ascription of responsibility and awareness of consequences (Stern et al., 1999). In other models, such as the TPB and TIB, beliefs are viewed as a moderating variable to attitudes, subjective norms, and perceived behavioural control (Ajzen, 1991).

Behavioural beliefs are thought to influence an individual's attitude towards a behaviour; normative beliefs underlie subjective or personal norms; control beliefs shape the perception of behavioural control (Ajzen, 1991, 2005). Klöckner (2013) describes a belief as "the expectation that showing a behaviour would result in a certain outcome, the likelihood that that happens and the evaluation to which degree such an outcome would be favourable" (p.1029). Based on this description, beliefs are, therefore, intertwined with the four cognitive mediating processes of the PMT (e.g. beliefs regarding the probability of an event happening and how severe it will be (vulnerability and severity), beliefs pertaining to the expected outcome of the alternative behaviour (response efficacy), and beliefs about the confidence to act (self-efficacy). These types of beliefs appear to be very important for this study inasmuch as farmers' perception of what is going on around them, and about themselves, are likely to be central to decision-making. For example, farmers who do not believe in climate change are unlikely to perceive that there is a threat to their operation. Farmers

who do believe in climate change, but do not believe that it will affect them, are similarly unlikely to change any practices or take any precautions. For those who do believe that climate change is a threat and believe that it will affect them, their beliefs on how best to take precautions, and whether they can implement them, are likely to guide farmers in their choice of approach.

Values and beliefs are intricately linked to attitudes, which invites their inclusion as a separate construct in the conceptual framework. Values underlie attitudes and refer to an evaluation of specific and abstract objects, people, issues or concepts, which can vary on a scale from positive to negative (Jonsson & Nilsson, 2014; Schwartz, 2012). If a concept promotes or protects the attainment of a personal goal, an individual's attitude to that concept will be positive. Conversely, if a concept threatens a goal, the individual will have a negative attitude towards it. Chapter 2 described examples of the environmental degradation that is currently taking place in Aotearoa New Zealand that may influence farmer decision-making. The value that is placed on the land influences the emotional connection to it, which is often shaped by experiences in nature that are connected to childhood and family memories (Chawla, 1999). Having grown up on a farm, for instance, can form a deep bond and connection to the place, which may translate into strong feelings to protect it from harm and perceived threats. Habitat destruction and pollution of that land could thus threaten held values related to achievement and security, which an individual will strive to uphold by addressing the threat. Farmers' beliefs and attitudes towards certain options may also influence which alternative behaviours they consider. Seeing the central role that values, beliefs, and attitudes are likely to play in decision-making, it was deemed appropriate to include them all as influential factors in the conceptual framework.

Norms

Barr (2011) outlined two major questions that farmers ask themselves when considering adopting new practices: "is this financially feasible?" and "what will our community think about this?". In this view, a reasonably wealthy farmer who is not overly concerned with what the community thinks of his or her idea to adopt new practices has fewer barriers to overcome in the decision-making process than those who are less wealthy and more concerned about what society will think. Small et al. (2015) found that early adopters in the Aotearoa New Zealand farming community (who tended to be wealthy, risk-tolerant, more influenced by mass media and less attached to local networks) were less afraid of potential failure and what others in their network and society will think of them. They might be more influenced by rumours and news affecting the industry, and more perceptive of consumer trends. This information might motivate them to change practices to remain at the forefront of the industry and retain a relative advantage, or to change practices due to a change in attitude regarding environmental impacts.

Norms are integral parts of the VBN, TPB, and TIB, and are instrumental to the creation of intention and behaviour. The definition of norms in the TIB relate to the customary codes of behaviour in a society about what 'should' or 'should not' be done (Egmond & Bruel, 2007). For example, it could be a social norm that people shake hands when they meet. This is something that an individual might not feel comfortable doing for personal reasons, but the social norm poses an informal 'prohibition' on not conforming. Going against a social norm can cause considerable distress as people will think you have acted inappropriately, which might affect your self-esteem and social standing (Läpple & Kelley, 2013). As such, norms can aid in shaping our attitudes and intentions (Klöckner, 2013; Terry & Hogg, 1996).

In the TPB, norms are described as subjective. Subjective norms refer to the individual's perception and beliefs regarding the social norms (Ajzen, 1991), meaning that your beliefs may differ from reality; you may think that your peers and people in society will approve, or disapprove, of a certain behaviour, but you could be wrong. If we believe that society will not agree with a chosen course of action, we might hesitate to act so as to avoid social rejection (Burton & Paragahawewa, 2011; Terry & Hogg, 1996). An individual's intention is responsive to social norms, and the decision is based, in part, on how the individual thinks that society will react to the behaviour (Ajzen, 2005). The intention or motivation to perform the behaviour increases if the behaviour is supported by society, which has been affirmed by Läpple and Kelley (2013) in their study on farmers converting to organic production in Ireland.

Values and beliefs are inextricably linked with personal and social norms. Personal norms, as part of the VBN theory, relate to personal feelings of obligation and are specifically important for complex decisions that are not supported by social norms (Stern et al., 1999). Personal norms can be a force for social change that is activated by strong beliefs that something an individual values is being threatened (Stern, 2000). An example of this could be a farmer that strongly believes that feeding supplements is negatively affecting cows' health and, hence, only feeds his or her cows grass. The social norm might be to feed supplements as well as grass but may change if this one farmer's belief spreads through the wider community. Whether or not individuals are inclined to accept social norms would depend on their values regarding self-direction and conformity (Schwartz, 2012). An individual who places a high value on self-direction may thus be less inclined to conform to society's expectation of appropriate behaviour if this is not in line with their goals. Rogers (1983) explained that 'social approval' could be seen as an extrinsic reward being part of threat appraisal in the PMT thereby specifically mentioning norms although it was not included as a separate factor in the model. The interactions between norms, values and beliefs invites the

inclusion of norms (both personal and social, as well as subjective and actual) as influential factors to be explored in the conceptual framework.

3.3 An emerging conceptual framework to explore

Since many of the challenges that dairy farmers in Aotearoa New Zealand are facing are likely to induce a sense of stress that influence threat and coping appraisal, the PMT was deemed appropriate to use as a starting point in the development of the conceptual framework (Figure 11). Although the PMT was originally based on fear appeals and persuasion, later additions to the model (Maddux and Rogers 1983; Rogers, 1983) have made it sufficiently broad to apply to situations that involves any type of threat (Rogers, 1983). Additional factors were found through literature review to be important in providing insight into farmer decision-making. Many of these relate to what the PMT termed 'sources of information' but was renamed 'influential factors' in the conceptual framework.

The additional factors were identified to specifically help provide insight into why dairy farmers have adopted, or are considering adopting, certain practices or production systems or, conversely, maintaining their current system. To address these objectives and to fully understand the main processes involved in decision-making, the addition of these influential factors was necessary.

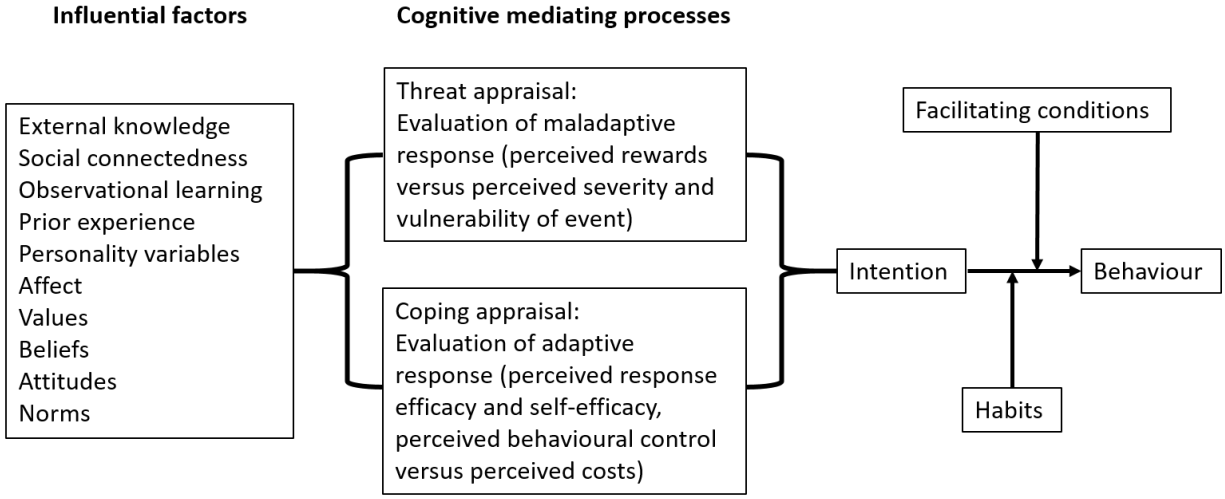

Figure 11. Modified version of the Protection Motivation Theory (PMT), which will act as a conceptual framework and basis for methodological approach for this study.

How farmers perceive threats and coping depends on their individual context and what type of farming system they are currently operating. There is a multitude of things that can affect an individual's context, either enabling or hindering an intention to translate into behaviour. As such, it was deemed necessary to include facilitating conditions and habits (from the TIB) in this study to

properly explore how opportunities for change are created and barriers overcome as it is widely acknowledged that intentions do not always lead to actual behaviour.

To cope well with changes in society, industry, or on a personal level, an alternative behaviour must be perceived to have a relative advantage or superiority to the idea or practice that was in place before it (Pannell et al., 2006) and the change must be able to be implemented. The discussion on the difference between the PMT's self-efficacy concept and the TPB's perceived behavioural control highlighted that they are likely indicative of internal and external drivers respectively. Both types of drivers are likely to exert influence on the decision-making process of farmers and are likely to interact in ways that make the concepts difficult to separate. As they are similar in terms of having an effect on coping appraisal, perceived behavioural control has been included as a factor under coping appraisal in the conceptual framework.

Aside from the above named additions to the original PMT model, this thesis also presents a few minor changes in wording. 'Protection motivation' in the original model (Figure 7) is renamed 'intention' in the conceptual framework, as Rogers (1983) states that protection motivation is best measured by intentions (although he also acknowledges that the variable can be measured in several ways). This does not mean to say that motivation and intention are conceptually synonymous. Rather, it reflects that motivation processes may create behavioural intentions (Schwarzer, 2016). The two coping modes, adaptive and maladaptive coping, are replaced by the simpler term 'behaviour' with the acknowledgement that it includes both direct action (changing something) and the inhibition of action (staying the same).

Since some of the factors have slightly different definitions as described by their creators, this thesis will use the TPB's definition of belief. The label 'norms' include both social, personal, and subjective norms as defined by the TIB, VBN, and TPB, respectively. The factors that are specific to a particular model will retain the definition their creators gave them.

The conceptual framework will act as an analytical tool to help highlight the role of the factors and processes included in Figure 11 on the decision-making of dairy farmers in response to stress. It will thus guide the investigation of farmers' responses to current challenges in Aotearoa New Zealand society today. The framework has acted as a starting point for the choice of methodological approach, which will be described in detail in the next chapter.

4 Methods and methodology

This study aims to understand dairy farmers' decision-making when considering whether to change practices or production system in response to external stresses by (1) identifying what type of changes dairy farmers choose to adopt or have adopted, (2) the reasons behind those choices, and (3) to show the main processes involved in dairy farmers' decision-making.

In order to appropriately address these objectives, the research philosophy adopted in this thesis is interpretivism. Interpretivism has a subjectivist perspective accepting that social and physical entities do not exist in isolation (Saunders, Lewis, & Thornhill, 2009), the interactions of which are extremely important to decision-making as outlined in Chapters 2 and 3. The research question and objectives will be answered based on farmers' perceptions and how they see the world because they are the key decision-makers. The purpose of this research is to create understanding and interpretations of their reality and lived experience. Decision-making processes are, therefore, best examined by exploring individuals' own narratives and opinions where their knowledge and context can be properly taken into account. As farmers' decisions are usually not based on rational choice and objective assessments of facts, it is paramount to understand decision-making from their individual perspective and perceptions (Darnhofer et al., 2011). The epistemology in this thesis thus assumes that the farmers' knowledge is credible, valid and legitimate.

The choice of research strategy and design is largely governed by the nature of the research question. This research focuses on investigating contemporary decisions, or those from the recent past, in their natural context. After reviewing the five different research methods identified by Yin (2014), it was concluded that survey- or case study-based approaches are most suited to reach the objectives (

Table 3).

Table 3. Research methods as identified by Yin (2014).

Context is important at all stages of the decision-making process, both in terms of appraising the threat and the capability to deal with the threat, but also in terms of whether or not the opportunity exists to follow through on an intention. As such, it is essential to choose a methodological approach which allows farmers to freely explain what made it possible for them (or hindered them from) taking a leap when changing practices or production system. This suggests a case-study approach, using interviews as a suitable data-gathering method.

The relative complexity of investigating both context and intrapersonal factors in this study influences the approach taken. The PMT has been used successfully to describe farmers' pro-environmental behaviour under drought in arid and semi-arid regions in Iran (Keshavarz & Karami, 2016). In that study, Keshavarz and Karami (2016) used self-administrated questionnaires to evaluate perceived vulnerability and severity of drought events, response efficacy, self-efficacy and response costs of adopting pro-environmental measures on farm. For something as tangible and specific as response to future drought, such an approach was appropriate. In this study, however, we are evaluating a multitude of potential threats that may induce farmers in Aotearoa New Zealand to change practices or production system in the future, or who have changed practices or production system in the past. As the participants will be asked to describe their decision-making process based on both internal and external factors, their perceptions and motivations are likely to present rich detail of a complex system in which they, the farmer and their family, are central.

Systems complexity demands a mixed-methods approach. The factors and drivers behind behaviour and decision-making are many-faceted, as we have seen in Chapters 2 and 3. The specific factors and drivers behind dairy farmers' choice of farming system in Aotearoa New Zealand are not pre-determined but are expected to be similar to those in previous studies. Employing a qualitative approach using semi-structured interviews was, therefore, imperative to establish which factors were important in this particular setting. A web questionnaire distributed to a larger number of respondents was added as a complement to the semi-structured interviews to test and

qualify those findings. This mixed-methods approach has an exploratory, sequential design as defined by Creswell (2015) and enables relevant drivers of complex decision-making to be captured and presented (Meempatta et al., 2019).

As the research involved both qualitative and quantitative methods, the chapter is structured in the following manner: the respective sampling, recruitment of participants and respondents, collection and analysis of data will be presented for each component in the order in which the research occurred. Finally, ethical considerations of the methods and the author's positionality is addressed.

4.1 Phase 1: Semi-structured interviews

Interviewing is commonly recognised as a highly effective method when dealing with analysis of subjective views, events and experiences (Flick, 2011). Interviewing allows researchers to ask how and why, through the use of open-ended questions, and to gather rich information so that feelings, beliefs, thoughts and behaviour can be understood. In his review, Alshenqeeti (2014) notes that four main forms of interviews are used in the social sciences: 1) structured, 2) unstructured, 3) semi-structured, and 4) focus groups. The main difference between these forms of interviewing is how much control the interviewer has over the progression and content of the interviews.

For this study, semi-structured interviews were chosen as the most appropriate method as these would allow the interviewer to ensure topics and themes found in the literature were covered while allowing participants to add topics that they felt were related. An interview guide is used to provide comparable data amongst participants while allowing them to lead the conversation into other related topics that the researcher may not have considered. Participants were able to talk about any aspect that they found important to their decision-making process and how it aligned with their worldview, which would not have been possible using a survey-type or structured interview approach. Focus groups would also not have yielded the same depth of information as the stories were often quite personal, and participants may have been uncomfortable sharing these in a group setting. The questions also do not need to be asked in order, as in a structured interview. The sequence is, instead, guided by the responses of the participant, with only a few prompts being necessary to keep the conversation flowing.

4.1.1 Sampling

The sampling process had to consider gathering comprehensive data whilst also taking context into account. A total of 30 interviews with dairy farmers were conducted. Throughout the sampling process, great care was taken to select a diversity of dairy farmers to provide a spectrum of views that would yield breadth and depth of information. Initially, 20 interviews (ten conventional and ten agroecological) were planned. This number was deemed sufficient to produce initial qualitative

results and basic quantitative differences between major variable categories. As recruitment was underway, however, it became evident that time would allow for a further ten interviews to be conducted. This enabled 15 interviews to be conducted within each production system category (conventional and agroecological) and allowed the researcher further opportunity to determine whether saturation had been reached. Although each participant's story was unique in many ways, the stories collectively shared similarities in thought-processes and decision-making. After the completion of approximately half the interviews, very few new topics or avenues of thought arose from the conversations, indicating that saturation had been reached.

Regional environmental regulations, climate and topography of farm, and available dairy processors are examples of contextual factors that may influence decision-making as explained in Chapter 2. If the context is ignored, the significance of events and actions can be distorted (Bewsell & Kaine, 2005). A farmer's choice thus depends on the context in which it appears. The contexts that were considered in the sampling process included different production systems (conventional, biological, or organic), different dairy farming regions, different processors (dairy company or independent), different times of conversion to agroecological practices (more than ten years ago or those recently converted/in the conversion process), and different family situations. These criteria were used to identify and select participants in an attempt to allow a diversity of views and will be outlined in more detail in the sections below. Table 4 presents some descriptive statistics of the participants.

	Number	**Per cent**
PRODUCTION SYSTEM		
Conventional	15	50%
Biological	8	27%
Organic	7	23%
TOTAL	**30**	**100%**
DAIRY FARMING REGION		
Modern	14	47%
Traditional	16	53%
TOTAL	**30**	**100%**
PROCESSOR		
Fonterra	14	47%
Synlait	5	17%
Open Country Dairy	4	13%
Independent	3	10%
Fonterra & independent	2	7%
Fonterra & other company	1	3%
Synlait & independent	1	3%
TOTAL	**30**	**100%**
POSITION ON FARM		
Owner-operator	25	83%

Sharemilker and owner	2	7%
Equity partnership	3	10%
TOTAL	**30**	**100%**
GENDER OF INTERVIEWEES		
Men	21	70%
Women	3	10%
Couples	6	20%
TOTAL	**30**	**100%**

Table 4. Descriptive statistics of participants based on production system, dairy farming region, processor, position on farm, and gender.

Production system

Sampling of agroecological (biological or organic) farmers was conducted first because, as described in Section 2.2.4, there is only a small number of agroecological practitioners. Due to the comparatively small size of the agroecological group, it was presumed that some would know each other and that snowball sampling could be employed as a method to find participants. The sampling logic of agroecological farmers was non-random, stratified, and purposive for maximum variation, with the objective to provide a diverse range of cases while optimising time and budget constraints.

Once the agroecological farmers had been recruited, conventional farmers were sought. Since meaningful comparisons between the two groups were desirable, the sampling logic for the conventional dairy farmers was also non-random, stratified, and purposive; each conventional participant had to fit certain criteria to qualify as a match to their agroecological counterpart. As far as was possible, they were first matched by geographic region to account for regional differences in regulation and climate. Second, they were matched by whether they were independent and market their produce themselves, or by processor, and if so, which one (e.g. Fonterra, Synlait, or Open Country Dairy). Finally, they were matched by herd size to allow for differences in scale of operation, and by family situation to allow for differences in priority setting depending on whether they had no children, dependent children or grown-up children.

Dairy farming region

Traditionally, dairy farming in New Zealand was developed in areas that had sufficient annual rainfall to grow the necessary feed without the need for irrigation or external inputs. Depending on the location, a farm might receive sufficient and evenly spread rainfall, whereas others might have to rely on extensive irrigation throughout most of the year. In order to allow for regional differences in governance and climate, participants were selected from different dairy farming regions in New Zealand. The traditional dairy farming regions of New Zealand are typically termed ‘summer safe’, due to an average annual rainfall greater than 1500 mm and uncommon occurrences of droughts and water stress (FAO, (n.d.)). Professor Jonathan Hickford from Lincoln University confirmed in a

personal comment that these regions include Northland, Waikato, Taranaki, Southland and the West Coast (Pers. comm. Prof. Hickford, 2016, November 2016). These regions are those where dairy farming was first developed in New Zealand. Canterbury, Otago and Central Plateau are examples of drier regions where dairy farming was generally developed later.

Modern (14) and traditional (16) dairy farming regions were determined, first, based on what the participants themselves said about the climatic conditions on their farms, and, second, on the average amount of rainfall in the region. Some farms might be situated in modern dairy farming regions, but due to microclimate or local differences in soil type, they have been placed in the traditional dairy farming region group. One example is Canterbury, generally seen as a modern dairy farming region, where some areas around rivers have been used for dairy farming for more than a century due to the ability to grow grass throughout the year with minimal irrigation.

Figure 12 shows the distribution of participant locations around New Zealand. Eight interviews (four conventional and four agroecological) were conducted in the North Island (Manawatu, Wairarapa, and Hawkes Bay). Thirteen interviews (six conventional and seven agroecological) were conducted in north and south Canterbury. Nine interviews were conducted in Southland and Otago (five conventional and four agroecological). For the preservation of the participants' anonymity, the exact location of each participant will not be disclosed.

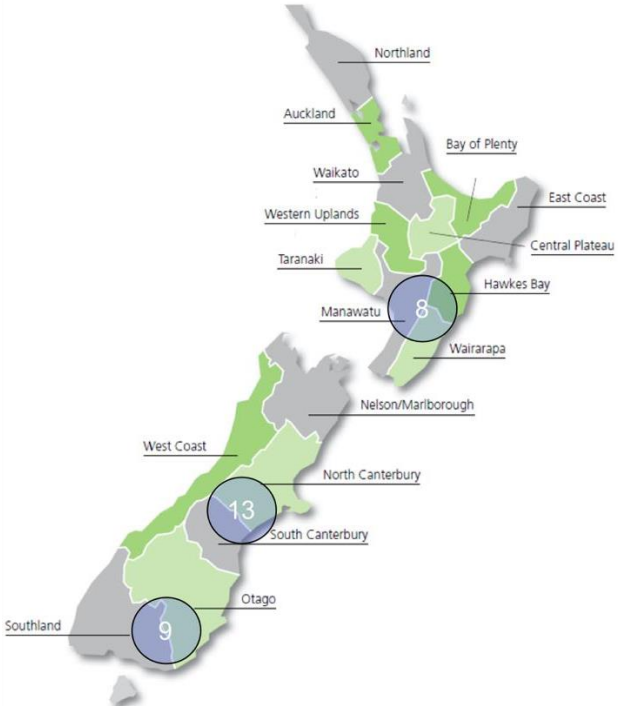

Figure 12. Map showing the distribution of participants in New Zealand (adapted from DairyNZ, 2018b).

Processor

It was important to interview farmers supplying a range of dairy companies due to the different value-add options offered, as described in Section 2.3.2. Fourteen participants supplied Fonterra, five supplied Synlait, and four supplied Open Country Dairy. One participant supplied both Fonterra and another small dairy company. It was also important to hear views from farmers who have opted to add value to their products through direct marketing. Three participants were fully independent and marketed their own milk products such as raw milk. The remaining three participants supplied both a dairy company and marketed their own dairy products (two supplied Fonterra, and one supplied Synlait).

Position on farm

Owner-operators can be assumed to have both a strategic and hands-on perspective on the farms they operate and do all of the decision-making regarding which system to run and which practices to employ. Owner-operated farming is the dominant ownership structure globally (iPES-Food, 2016) as well as in Aotearoa New Zealand where about 60% of the 11,590 dairy herds were managed by owner-operators in the 2017/18 season (DairyNZ, 2018a).

Farmers who are either contract milking, sharemilking or in equity partnerships may likely have less decision-making power than owner-operators. For instance, variable order sharemilkers (12% of farmers) operate and manage the farm to varying degrees but often do not own the cows or the land (DairyNZ, 2018b), which could imply that the owner largely decides which production system to operate and how the animals should be managed. Contract milkers (12% of farmers) are only paid according to the quantity of milksolids they produce and the amount of work they do on the farm (DairyNZ, 2018b), which may imply that they are in a similar position in terms of decision-making as variable order sharemilkers. Herd owning sharemilkers under 50/50 agreements (16% of farmers) own the herd and likely have a bit more say in the management of the animals but perhaps not over which production system to operate. An absentee owner may have a different perspective than the staff, contract or sharemilker on what kind of system the farm would be best suited to. Depending on the nature of an equity partnership, farmers may have more or less decision-making power in larger-scale decisions, such as which production system to employ on the farm. They may also have additional pressure to perform financially due to demands from the equity partner. Conversely, the farmer could enjoy full autonomy over decisions made on farm, which highlights that level of decision-making power can be very individual.

In order to target farmers with long-term thinking in terms of farming strategy and with decision-making power, primarily commercial, owner-operated dairy farms were contacted. Targeting

owner-operators with a high level of decision-making power was preferred because it is likely that they evaluate their own farming system in the long-term and compare it to those of other farmers more than sharemilkers and contract milkers who have less decision-making power on the farms they work on. Two participants both owned a farm and were sharemilkers on another farm, and two were in equity partnerships but had a great deal of decision-making power in terms of practices and production system employed on farm. Another participant was in an equity partnership where the farm was bought with the help of his family. He was involved with all higher-level decisions from a strategic point of view in terms of which practices or production system to employ, but the day-to-day running of the farm was delegated to a contract milker. It was not known prior to meeting these three latter participants that they were in equity partnerships and not outright owners of their farm. The high level of decision-making power and involvement with the farm that they explained they had were, however, deemed enough to be able to compare them to the owner-operators interviewed in this study.

In their annual economic surveys, DairyNZ (the national industry body representing New Zealand's dairy farmers) only includes data from farms that are commercial and derive at least 70% of gross farm revenue from dairy farming (e.g. DairyNZ, 2016). To ensure that dairy farming was the main business of the participants, these limits were observed in this research as well, as far as was possible, without asking directly about gross farm revenue.

Gender

The majority of participants interviewed were men by themselves (21), followed by couples (6), and women by themselves (3). Due to the challenges of finding farms that fit the other conditions (production system, location, dairy company etc.), obtaining a completely balanced selection between men, women and couples was impractical given the time and resources available for this study. In many cases, the interviewer did not know until arrival at the farmstead whether one or both partners would have time to talk. Although important for investigating differences in perspective, gender was not directly addressed because many New Zealand dairy farms are run in partnership between husband and wife or as a family, which was also the case in 25 of the 30 interviews conducted in this study.

Time of conversion

During sampling, care was taken to interview those who are in the conversion process to agroecological practices as well as those who have been organic or biological a long time. It is suggested that individuals can present reasons for actions and behaviour that may, in fact, not have been true at the time and that this becomes a greater problem the further in the past an event is

(Flick, 2011; March, 1972). For those dairy farmers who converted from a conventional to an agroecological system more than ten years ago, their memory of why and how they converted from one system to another could be less accurate than a farmer who changed system more recently. On the other hand, they may also have been able to reflect more on their choice and would, therefore, be able to give a more analytical view of the reasons behind their choice. This trade-off was deemed necessary and appropriate for this study as the richness of information builds on hearing from a spectrum of participants within each production system group. Within the organic group, three had been organic for more than ten years. In the biological group, two participants had been biological for more than ten years.

4.1.2 Recruitment

Recruitment of participants commenced by contacting those who were known to the interviewer personally; three farmers and four rural professionals. The rural professionals were very helpful in referring ten agroecological farmers and one conventional farmer to the interviewer. Officials from two of the dairy companies, Open Country Dairy and Synlait, provided an additional four conventional farmers. Another four conventional participants were sourced from social media platforms (Facebook group 'NZ Dairy Association') where a message was posted asking interested people who fit the criteria to contact the interviewer. Two agroecological participants were emailed after finding their business websites online. The remaining six participants were snowball-sampled from the previous participants' networks. See Table 5 for a depiction of the recruitment strategy and the number of participants gained from each recruitment strategy.

Recruitment strategy	**Number of participants**
Personal contacts	3
Direct email	2
Facebook	4
Open Country Dairy contact	1
Synlait contact	3
Rural professional in organic farming	3
Rural professional in biological farming	2
Rural professional in organic and biological farming	2
Rural professional in holistic farming	4
Referred to from other participants	6

Table 5. Participant recruitment strategies and the number of participants gained from each.

The majority of prospective participants were contacted directly by phone to see if they were interested in taking part. If they indicated their interest, an email was sent with more detailed information about the research (see Appendix A) and a request for prospective dates for the interview. Only three were contacted solely through social media (Facebook) prior to meeting them in person.

4.1.3 Collection

The conceptual framework presented in Chapter 3 (Figure 11) acts as a basis for the methodological approach in this study. An interview guide was created based on those factors aimed at capturing the participants' reasons behind adopting their current farming system and whether they have any intentions of changing their system in the future, and why (see Appendix C). The interview guide was created to facilitate the interviews and to be able to increase reliability so that comparisons between participants' responses could be made.

Three trial interviews were conducted between 23rd November 2017 and 15th January 2018 in order to test the initial interview guide prior to data collection. The interview guide had to be tested in a real situation in order to determine whether any questions were unclear, were not useful for the study's aims, or had not been included. In response to the trial interviews, the interview guide was refined to include more detailed questions on the relative advantage of the participants' chosen system and if they experienced any particular barriers or enablers that made the decision easier or more difficult to make. Other questions relating to participants' thoughts on the dairy industry as a whole were added in order to receive more in-depth information. The trial participants were asked to give feedback on any questions they thought were unclear or needed further explanation, and their comments were heeded.

The interviews were recorded with the participants' permission. To build rapport prior to the interview, the interviewer's personal background was explained, as well as the connection to New Zealand and the reasons for conducting this particular research. Since Patton (2002) states that it is best to start the interview by asking nonthreatening questions to allow the participant to relax and allow the interviewer to create rapport, each interview started with a fairly broad question: 'Could you please tell me the story of how you arrived at managing your farm in this way?'. This question was designed to let the interviewee tell their story in a way that made sense to them. Most started off describing their farming system before moving on to describing what they like about their system, what does not work so well, and how they might change it in the future. The participants' values and goals often became very apparent through this first question. If they didn't mention it themselves, follow-up questions were asked to make sure that the factors in the conceptual framework were covered, such as 'did anyone or anything specifically influence your decision?' (e.g. external knowledge, observational learning, habits), 'what conditions made it possible to adopt this system?' (e.g. facilitating conditions, perceived behavioural control), and 'was there anything that made the process of starting to use these practices challenging/easy? (e.g. self-efficacy, norms, prior experience).

Questions pertaining to personal background were then asked if not already made apparent during the initial question. These questions were designed to understand more why the participants had chosen dairy farming as a career (e.g. values, personality variables), how long they have been dairy farming, and who comprised their support network (e.g social connectedness). Personality variables was the factor that was the most difficult to gauge without applying the Five-Factor Model (also called the 'Big Five') or the HEXACO, to measure and understand differences in behaviour among individuals (Ashton, Lee, & de Vries, 2014). The traits openness to experience, conscientiousness, extraversion, agreeableness and neuroticism of the Five-Factor Model could, for instance, have been used to design questions based on the Revised NEO Personality Inventory. In order to make comparisons between participants, however, the questions would have had to take a form similar to a structured questionnaire, which is not the methodological approach employed in this thesis. Instead, personal characteristics were reported by the participants themselves in conversations regarding their perception of risk, response to threats, and how they interact with people around them.

These types of characteristics also came to the fore in the second part of the interview schedule, which asked the broad question: 'what do you anticipate for/think of the future of dairy farming in New Zealand?'. This question was designed to bring out any challenges that the participants' perceive in terms of the dairy industry as a whole, but also to relate them to their own farm and context. This question, together with the sub-questions outlined in the interview schedule, brought out the participants' beliefs and attitudes, how they might have to change their system in the future in response to these challenges (threat appraisal), and how well placed they are in controlling that response (coping appraisal). The discussions during this part of the interview were wide-ranging and depended on the interviewee's circumstances and context, and on how resilient they perceived their own system to be in relation to the perceived challenges at hand, and if there was a clear relative advantage or opportunity to change their practices or production system.

Due to the often emotion-laden discussions about opportunities and threats, it was appropriate to finish the interview with a non-threatening question. Each participant was asked: 'what, in your view, is the best thing about being a dairy farmer?'. Aside from being non-threatening, the question was also designed to prompt the participant into describing feelings of affect and values around their choice of profession. Finally, each interview ended with asking the participant if there was anything more that they wanted to add or if there was something that they would like to talk about that was not asked. This was also an approach described by Patton (2002) in order to allow the participant to determine when, and if, the interview was over.

Actual data collection took place between 26th January and 25th May 2018. This time was chosen because late summer and autumn tend to be a less busy time for dairy farmers. Calving, which is the busiest time of year for dairy farmers, usually takes place between August and October depending on where in the country they live and whether or not they do seasonal supply. Seasonal suppliers tend to 'dry off' their cows around the month of May and then have a break before calving begins. There were seven participants who supplied milk through the winter as well as through the summer. This was not known prior to the interviews taking place.

To get a nuanced picture of the story behind farmers' decision-making and to build rapport between interviewer and participant, it was necessary to interview farmers face-to-face during the qualitative phase of the study. Every interview took place on the participant's farm, usually at the farmstead. Talking to participants face-to-face on their farms was important so that they were able to explain and show the interviewer aspects that had influenced their decision-making. This could include certain infrastructure, equipment or physical features in the landscape. It was also important to meet in person in order to build rapport and trust between the interviewer and the participant.

Notes were also taken during the interviews to protect against the potential loss of data through technological (dictaphone) breakdown. Only one participant declined having the interview recorded, which led to extensive note-taking as a substitute. The same day after each interview, these notes were re-read and the main points, as perceived by the interviewer, were noted. At a later stage, all recorded interviews were listened through and additional notes made. Each participant was emailed and asked to review the account for accuracy and potential clarification if there was anything that was unclear from the interviewer's side. Twelve farmers replied with clarifications and/or comments, which led to the transcripts being modified to reflect the true intent and meaning of the farmers' accounts.

4.1.4 Data analysis

Each recorded interview file was converted to mp3 and imported into QSR International's NVivo 11 qualitative data analysis software, which was used to transcribe and analyse the interviews. A simple transcription system, as described by Dresing, Pehl, and Schmieder (2015) was used as a guide and amended to suit the scope of analysis. Dialect and colloquial language were approximated to standard language, and sarcasm, irony and jokes were specified as these otherwise can be misleading in plain transcribed text. Certain elements of non-verbal communication were marked in the transcribed text such as 'laughter', 'thoughtful pause/silence', and 'agitated'. If a participant was showing the interviewer something with their hands, this was

noted as well. Elaborate transcription systems were deemed unnecessary for the aim of this study as the focus is on the content of the conversation. Pitch of voice, speed, volume, intonation, speech melody, as well as some non-verbal and para-linguistic elements, were therefore not part of the interpretation. A full list of the transcription rules used can be found in Appendix D. After initial transcription, each interview was listened through a second time to check and correct any errors to the text.

The interviews were interpreted both on a thematic basis structured around the categories as set out in the conceptual framework presented in Figure 11, but also by using an approach similar to Grounded Theory (Glaser, 1992; Strauss, 1987). The variables of interest thus included both pre-defined categories as well as those derived from the transcripts to address themes that emerged as important to the participants. By defining sub-categories, a finely structured and differentiated set of categories was established. Working from the developing narrative, more detailed insight into the complexity of decision-making could be achieved than if just the pre-defined categories from the conceptual framework had been used. The conceptual framework thus acted as a guide to data analysis so that flexibility in coding could be retained and other relevant information and factors could be added.

4.2 Phase 2: Web questionnaire

The second phase of the research design was the quantitative survey. A web questionnaire was distributed to dairy farmers nation-wide, with the intention of confirming whether the findings of the semi-structured interviews could be supported or rejected among a greater sample of dairy farmers. The term 'respondents' refers to those who responded to the quantitative web questionnaire, as opposed to the term 'participants', which is used to refer to those who participated in the qualitative semi-structured interviews.

The software Qualtrics™ was used to generate the survey. In total, the questionnaire consisted of 36 questions, of which 33 were multiple-choice, matrix-type, or slider-type questions. The remaining three were text-box questions where respondents could write freely. The questionnaire was divided into four blocks: 'General information', 'Current farming system', 'Future farming system', and 'Perceptions'. The 'Future farming system' block, consisting of ten questions, would only become available to those who did not actively select the option: 'I do not think that my current farming system will change much going forward'. These respondents were also able to answer a text-box answer question asking: 'What would help you reach your ideal future farming system?'. The other participants were asked a similar question but pertaining to their current system: 'What would help make your current farming system easier to manage?'. All respondents were able to

answer ‘If you could choose freely, how would you improve the industry and dairy farmers’ situation?’. The full questionnaire and display logic can be viewed in Appendix E. Respondents were allowed to answer as many or as few questions as they desired.

Care was taken to cover similar contexts in the questionnaire that were considered in the sampling process of the qualitative phase (Table 4): different production systems (conventional, biological, or organic), different regions, different processors (dairy company or independent), different family situations, and gender. Different times of conversion to agroecological practices (more than ten years ago or those recently converted/in the conversion process) was not included in the questionnaire. This is an unfortunate omission since it presents a limitation in that it excludes the ability to analyse the influence of time on other questionnaire responses. The rest of the questionnaire was constructed in accordance with the results of the qualitative phase and will be discussed further in Section 5.4.

The questionnaire was trialled with one conventional dairy farmer who gave minor but useful feedback on the framing of the questions prior to it being distributed.

4.2.1 Sampling

For the questionnaire, all dairy farmers that could be contacted by the methods described below were invited to take part. The only criterion was being a dairy farmer who was both residing and working in Aotearoa New Zealand. Any respondents who did not fit this criterion were excluded from the analysis. The rationale for including all positions on farm and not just owner-operators as in the qualitative phase, is grounded in the construction of the questionnaire itself. It was presumed that farmers, regardless of position on farm, would be able to accurately describe the farming system they were currently working in, as well as reasonably explain the reasons why that system had been chosen. Regardless of position, they would also be able to describe their ideal future farming system and the reasons behind choosing that. Similarly, their perceptions of the dairy industry and how concerned they are regarding certain challenges, is also not likely tied to their position on farm. Despite this reasoning, there is still of course a risk that farm workers, contract or sharemilkers would not be able to accurately describe the reasons for the current farming system they work in. Including all positions on farm in the sampling also offered an opportunity to see whether there would be a difference in responses between groups, but subsequent data analysis showed no significant differences in responses in relation to position on farm.

4.2.2 Recruitment and collection

Due to a lack of assistance from farmer interest groups or industry[4], the survey was distributed online using an anonymous link. Since a database of dairy farmers was unavailable, the link to the questionnaire was distributed as widely as possible, using three means.

The first means of recruitment used social media through Facebook. Pages thought to contain a large number of members who were dairy farmers were targeted such as 'NZ Dairy Association' (33,300 members), 'NZ Farming' (159,000 members), and 'Manawatu dairy discussion group' (250 members). The link was posted several times in these groups due to the high number of respondents recruited each time. Other groups, such as 'Federated Farmers' (7,300 members), 'DairyNZ' (19,000 members), 'New Zealand Alliance for Raw Milk' (2,500 members), 'Support biological farming in NZ' (685 members), 'DairyCare NZ' (1,600 members), and 'Dairy Women's Network' (7,900 members), were also targeted, but only once or twice due to the low number of respondents recruited. Personal connections were also contacted via Facebook and asked if they would share the link to the questionnaire to any of their connections who were dairy farmers.

The second method employed involved publishing an online article in *Dairy News* through the Rural News Group. The article was published on December 12, 2018, and provided information about the research and a link to the questionnaire (Rural News Group, 2018).

Finally, emails were sent to the researcher's personal network, who were either dairy farmers or rural professionals. The emails encouraged them to distribute the link through their networks. One of them said that they managed to get the questionnaire distributed through the ODPG emailing list.

In total, 182 responses were collected through the use of these three methods. Due to the link being anonymous, it is impossible to know exactly how many respondents each method recruited. Based on daily observation of the collection count, however, it is suggested that Facebook as a means of respondent recruitment is highly effective. Once the article was published in *Dairy News*, the link to it was also used in the posts on Facebook, which seemed to improve recruitment rates. This suggests that a combination of recruitment methods could be advantageous for similar research.

[4] In order to reach as many dairy farmers as possible, the initial plan was to gain assistance from DairyNZ, who have a database of all levy-paying dairy farmers to whom they occasionally send surveys. Such a list includes the majority of dairy farmers in New Zealand. This was, however, not possible as representatives of the organisation did not want to seem to endorse any specific kind of research. They also mentioned that they send out a lot of correspondence to farmers through the database and did not want to use it unless necessary and in the organisation's direct interest. A similar response was also received when asking other relevant organisations such as Federated Farmers, Fonterra, Synlait and Open Country Dairy.

4.2.3 Data analysis

The closed-ended questions were analysed quantitatively using the software IBM SPSS Statistics 25. The open-ended questions in the questionnaire were subjectively grouped into themes and analysed without statistical procedures.

4.3 Ethical considerations

The methods used in this research project were reviewed and approved by the Lincoln University Human Ethics Committee (qualitative phase: application number: 2017-39; quantitative phase: application number: 2018-38). In accordance with the ethics approval, signed consent forms were collected from each participant before the interview began. The consent form can be viewed in Appendix B. The research information sheet (Appendix A) was sent to participants once an interview had been scheduled, in most cases weeks in advance. The main points made in the research information sheet were reviewed in person before commencing recording prior to the interview so that participants were aware of their voluntary contribution and their right to refrain from answering any or all of the questions.

No individual identifying information of the participants has been provided in any written or oral presentations. Unique identifiers (agroecological participants were coded as A-O and conventional participants as A2-O2), which maintain anonymity, have been used throughout this thesis. Location of each farm has only been recorded by general dairy farming region to protect the participants' privacy. All results have been aggregated at the group level. Any quotes have been anonymised and used only with the permission of the participant.

A small risk existed that participants could experience emotional distress when talking about stressful events, which have influenced their decision-making process. Farming can be stressful due to a number of events such as volatile markets, extreme weather events and social conflicts, which may evoke difficult memories of past experience. The interviewer remained vigilant for any signs of distress. If any had occurred, the interview would have been carefully terminated at that point.

There was also a small risk of participants taking unintentional cultural or moral offence from the interviewer through ignorance of certain Māori (the indigenous population of Aotearoa New Zealand) or Pākehā (descendants of European settlers) customs. To minimise this risk, the interviewer was open about not being a national of this country and was prepared to ask questions if unsure of how to act. The risks were further minimised by clearly and carefully explaining the research and the reasons behind the questions, and responding to answers in a non-judgemental way. The interviewer was prepared to shift the focus of questioning if a participant had shown signs of emotional discomfort.

4.4 Positionality

An implication of choosing an interpretivist approach is that the values and beliefs of the researcher plays a role in the interpretation of the data (Saunders et al., 2009). Although I had experience working on farms prior to conducting this research, I had no experience of the operation of dairy farms. This was a conscious decision in order to minimise bias in an interview setting where any prior experience would potentially influence my reactions or questions. Not having prior experience in dairy farming allowed me to ask basic questions that the interviewees responded to and thereby often revealed underlying values and beliefs regarding their practice use or production system.

My interests in the topic of this thesis stems from my early adult years when I was employed on a conventional sheep and beef farm in Scotland. Being (then) part of the EU, I came to understand that the farm was only financially viable due to the subsidies from the Common Agricultural Policy. I saw the farmer's stress but also his equanimity when reflecting on the situation – that was the way it was and there was nothing else to do than play the game according to the rules set out. My experience working on organic and conventional sheep and beef farms in New Zealand was starkly different. Here, farmers were generally wealthier, had more autonomy and could choose whichever system they wanted with a great deal more ease than they could in Scotland (or in Sweden where I am originally from). That initially made me value the subsidy-free system and how that must be much better than a system that is subsidised. On the other hand, however, environmental problems associated with agriculture are on the rise in Aotearoa New Zealand, whereas in Europe they are largely reducing, thanks in part to regulation and subsidies and premiums aimed at encouraging pro-environmental behaviours on farm. Agroecology has become an increasingly important topic in the EU where the European Commission are acknowledging how such practices and production systems could provide a profitable, environmentally and socially sustainable alternative to conventional systems (ARC2020, 2020; EIP-AGRI, 2020), which has led to the encouragement of research into those areas (e.g. LIFT (2020), PEGASUS (2020), UNISECO (2020)). In Aotearoa New Zealand, however, it was a very niche movement when I first looked into embarking on this thesis, and I was interested to see how and why farmers choose these types of practices in a largely subsidy-free system. This is the background against which I chose my research topic, which needs to be taken into account when reading through the interpretation of the data. Although a lot of care has been taken to avoid bias in personal interactions with farmers, in constructing the interview schedule and the questionnaire, and in the data analysis, it must be acknowledged that some personal bias cannot be ruled out.

I strongly assert that there are multiple ways of sustainably operating any farm, be it a dairy or sheep and beef farm. Just because one system is organic and the other conventional, for instance,

does not mean that one is by default better than the other. As in all things in life, the context and multiple factors, such as profitability and the welfare of staff and animals, have an influence. My choice of theoretical and methodological approach to this thesis has been to mirror this assertion that nothing exists in isolation, that people generally have sound reasons for their choices, and that people generally have no intention of deliberately harming the environment, their animals or society. The difference in choice may instead lie in how we perceive the world around us and how we relate it to ourselves as human beings and our lived experience and reality.

5 Qualitative results

The first and second objectives of this study were to identify which practices or production systems dairy farmers have adopted, or would like to adopt or maintain in the future, and why. This chapter, therefore, starts with an overview of the different practices participants in the qualitative phase of the mixed-methods design currently use or would like to adopt in the future. The perceived benefits and outcomes of each as reported by the participants will also be presented. The reasons for adopting an agroecological production system in particular is explored in part throughout this chapter, but is more strategically evaluated in Chapter 6 with the use of the web questionnaire. Categorising participants, and farmers in general, into definitive groups based on production system is also discussed, since this presented a challenge in this study.

The third objective was to synthezise theory with the results of the first two objectives to show the main processes involved in dairy farmers' decision-making. Direct verbatim quotes from the interviews will be used to highlight and clarify the emerging themes based on the conceptual framework presented in Figure 11 and an approach similar to Grounded Theory. Then, the themes will be discussed in terms of which of them seem to be central to the decision-making process. This evaluation was the basis upon which the web questionnaire was constructed, which will be presented in the fourth part of this chapter.

5.1 Present and future choices

As described in the previous chapter, the participants were asked at the start of each interview to describe what kind of farming system they operate and the reasons behind choosing that particular system. The first half of the interview thus centred around talking about the events, thoughts or experiences that have led the participant to their particular choice. The second half of the interview explored in further detail the participants' thoughts on the dairy industry, the strengths and weaknesses they perceive in their chosen system in relation to those thoughts, and what their goals are for the future. This provided a way to analyse the reasons behind the different choices that the participants had made in the past as well as the choices they may make in the future.

The time and place in which a decision occurs is of importance, as threats, and the perception of them, change with time. For example, the outbreak of *Mycoplasma bovis* in Aotearoa New Zealand in 2017[5] is likely to have influenced farmers' perception of biosecurity threats, whereas this issue may not have been at the front of their minds a year earlier. The perception of such a threat is also

[5] *Mycoplasma bovis* is a bacterium that causes a range of diseases in cattle. Since being found in Aotearoa New Zealand for the first time in July 2017, it spread to 250 farms. In an effort to eradicate the disease, MPI decided to cull all infected animals (Biosecurity New Zealand, 2019, 2020).

likely to be greater the closer to the origin of an outbreak an individual is. Being socially or physically close to an infected farm is likely to elicit a more forceful response. Time and place are, therefore, important elements to bear in mind during analysis of the data since the context of the farm and farmers is central to individual decision-making in the face of perceived potential threats.

The interviews revealed that there was a range of different practices and production systems that participants were currently employing or planned to adopt in the future. Seven general choices were identified among the interviewees: conventional, uncertified agroecological, value-add (including certified organic, A2, and grass-fed only), independent processing and/or retailing, business diversification, lower input, or lower intensity. Table 6 provides an overview of the different choices (both overall production system as well as variations to the production system) and the perceived benefits and outcomes of each. The choices are not mutually exclusive, which means that a participant could, for example, be biological, an independent producer and produce A2 milk. Another example is a participant who was conventional, once-a-day and produced winter milk. Any constellation is possible with the exception of running two major production systems at any one time (e.g. both conventional and certified organic). The table also outlines options for how participants may change their choice. For example, a participant may have previously run a conventional system but is thinking about moving into the certified organic space by choosing to supply a value-added product.

The different choices are also perceived to have many benefits in common. Consumer demand is for instance a perceived benefit of choosing a grass-based system, an organic system, as well as a conventional system. This indicates that the relative advantage of changing or maintaining practices or system could be seen as similar regardless of the choice; as long as there is a perception that the new practice or production system will be better financially, environmentally or socially than the current practice, the motivation or intention to change will be present. The perceived benefits and outcomes are presented here as an overview to illustrate the diversity of, and relationships between, reasons, which will be discussed throughout the rest of this chapter.

5.2 Categorising participants

As described in Chapter 4, participants were selected largely based on the three different production systems under investigation (conventional, biological, and organic). Throughout the course of this study, however, it became clear that such a definitive distinction can sometimes be difficult to make. As the participants explained their farming system, great variations within each production system became evident in terms of, for instance, intensity, choice of inputs, and scale.

Figure 13 shows a spectrum of the participants based on part of their subjective descriptions of their chosen farming system. The participants' synthetic and biological fertiliser management, aspirations for the future, and perceptions of agroecological production systems facilitated the allocation of the participants along the spectrum. Using fertiliser management as a tool for allocation was appropriate because this is one of the defining differences between the systems as outlined in Section 2.2; For instance, biodynamic farmers essentially strive for their farm to be a closed system with no external inputs in the form of fertiliser or feed.

Additionally, discussions about agroecological approaches facilitated the allocation along the spectrum. For example, some conventional participants were not convinced by agroecological approaches, whereas some were interested and had tried biological products in the past. The latter would then be placed closer towards the agroecological side than the former. Similarly, some biological farmers were not at all keen on the organic production system whereas others were actively looking at perhaps converting to organics in the future. There were two organic participants who had adopted aspects of biodynamic system, whereas the others were content with fulfilling the requirements of the organic certification whether or not they were certified. These were placed at opposite ends of the organic side of the spectrum.

Generally, the participants defined their own production system by telling the interviewer their category. However, each farmer's definition of their own system is affected by their understanding of how the different systems are defined and how they relate to those definitions, and this, in turn, will be influenced by their experiences with other practitioners. Especially biological participants struggled to see how their own approach fitted into any of the existing categories.

> *Father: "I struggle very much as to what our category is. Psychologically, I've an issue with organics. Financially, I've an issue with conventional farming. We really sit in no man's land. People like to label, pigeon hole, because the reason they want to do that, I feel, is because they don't want to put any more thought into it. So as soon as I say, I'm organic, ka-ching! You're that. Conventional. You're that. Biological is a later one that's come in. It's a third box. I don't believe we fall into the third box either… So what I'm trying to say is, we don't do as a label would have us believe we do." (L, biological farmers, Southland)*

This highlights that it can be extremely difficult to assign individuals to specific categories, which indeed raises the question whether it is useful to categorise at the basic level of three production systems (conventional, biological, and organic) as is done throughout this thesis. Each participant and their farming system is unique in their context, their goals, and their practices. Even if a participant is defined as conventional for example, that label does not adequately explain the

farming system as there is a range of different practices within each production system, meaning that two conventional farmers can have vastly different systems. An obvious example would be relying heavily on imported feed versus running an all-grass system. Despite its limitations, categorising participants according to production system was necessary in order to explore whether there were differences in motivations for choosing one production system over another. Although comparisons are made at the group level, it is important to keep the spectrum in Figure 13, and the challenge of defining distinct production systems, in mind throughout the rest of this analysis.

	Choice	Practice	Perceived benefits	Perceived outcomes
Production systems	Conventional	Industrial agriculture	Consumer demand Efficient Well-proven system Simple and flexible system	Competitive advantage – cows on grass is NZ's image Profitable Ease of management
	Uncertified agroecological	Biological	Improved animal, soil and environmental health Lower cost Less stress – off the treadmill Feels good	Better crops More resilient to incoming environmental regulations Better product Increased profitability More enjoyable
		Non-certified organic	Improved animal, soil and environmental health Feels good	Increased profitability More enjoyable
	Value-add	Certified organic	Consumer demand Premium Feels good More time with family Improved animal, soil and environmental health Improved human health "Sexy" business for young people	More resilient – can compete with synthetics Marketing advantage More enjoyable Nutrient-dense food/better product Succession made easier
Production system variations		A2	Consumer demand Premium	Market advantage – NZ needs to be unique
		Grass-fed	Consumer demand Premium	Market advantage associated with NZ Inc. – protect 'clean and green' image Improve public perception
		Winter milk	Premium Will not send cows off if they do not get in calf	Increased profitability
		Polled	Consumer demand – animal welfare	Future market advantage
	Independent processing and/or retailing	Raw milk	Consumer demand – quality, nutrition, and taste Niche market – can set own market price	Increased profitability
		Ethical milk	Consumer demand – quality, high animal welfare Niche market – can set own market price	Increased profitability
		Processed milk	Can set own market price	Increased profitability

	Choice	Practice	Perceived benefits	Perceived outcomes
Production system variations	Business diversification	Beef Lamb Crop	More income streams Brand extension	Increased profitability Increased flexibility Increased resilience to milk price fluctuations Mitigating risk (not all eggs in one basket)
	Lower input	Self-contained/ mostly grass-fed	Lower cost Can control everything Consumer demand Lower environmental impact More family time	Increased profitability Minimised biosecurity risks More resilient to changes of input prices Marketing advantage (cows on grass) More enjoyable
		Phase out penicillin	Ahead of the game – the writing is on the wall	More resilient to changes in regulation
		Phase out palm kernel extract (PKE)	Consumer demand Improved animal health Feels better – moral objection	Protect 'clean and green' image
		Less fertiliser/urea	Improved animal, soil and environmental health	Increased profitability
	Lower intensity	Once-a-day milking	Lower cost Improved animal health Less stress on people	Increased profitability More enjoyable
		Lower stocking rate	Low financial exposure More family time	Increased resilience More enjoyable

Table 6. An outline of seven different choices participants have adopted or wish to adopt in the future, and the perceived benefits and outcomes of each choice.

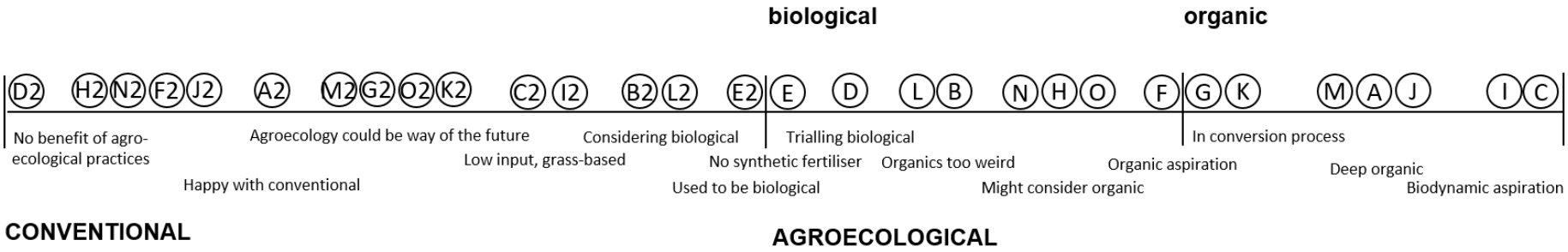

Figure 13. The spectrum of participants based on their descriptions of their fertiliser management, perceptions and aspirations.

5.3 Analysing pre-determined and emerging themes

The factors that were identified through data analysis to be of importance to participants' decision-making about their choice of practices and production systems are presented below using quotes from the participants to highlight the relevance of the factors to their decision-making. Although the factors are presented in separate sections, there are clear interactions that sometimes make them difficult to disentangle. It is important to note that the following sections discuss dairy farmers' subjective perceptions of the world and their attitudes in relation to their choice of system, rather than objective knowledge of different systems, in line with the interpretivist approach employed in this thesis.

The influential factors are presented below in the order in which they appear in the conceptual framework (Figure 11). Thereafter, facilitating conditions and habits are discussed as moderators of behaviour once an intention has formed. The two cognitive mediating processes, threat and coping appraisal, are then outlined. Finally, autonomy and significant events are presented as factors that emerged from the interview material that were not originally considered in the conceptual framework.

5.3.1 External knowledge

External knowledge is an original part of the PMT model and was found through literature review to have a marked influence on threat and coping appraisal in decision-making. The participants explained how they gain knowledge from a variety of sources. The two most notable ones were education in younger years, and, in later years, research disseminated through the farming community with the help of farming magazines, sales representatives, and industry bodies such as DairyNZ.

Most of the participants' testimony on education was mentioned very briefly as they had either been taught outside of the home or as part of an employment. Some looked back on their time in education as very useful for their farming career.

> *"The science that I did in university tells me that fertiliser is a good thing for soil…So this farm here, it had a low base fertility, so I've put more fertiliser on to increase my grass growth potential. Without those NPK additions, I don't know what this farm would produce." (N2, conventional farmer, Southland)*

Some of the agroecological participants, and those who were leaning that way, were rather impassioned when talking about educational institutions. They felt that those programmes teach students a specific kind of thinking and are not taught to think critically or alternatively.

"It's about driving the model, and part of it comes back to the education systems, like the likes of Lincoln. I've got a lot of friends who have been through Lincoln. Bloody great businessmen but they struggle to see outside this box. They're bloody good at following that model and operating within the model and making that model work really well. But at present, a lot of these guys are struggling. They can't see shit, what this might look like out there. The education system, it just does not encourage people to actually think differently." (L2, conventional farmer, Southland)

Father: "Ignorance is not bliss. In this situation. I feel for the younger farmers who don't, at that stage, know any different…If I see a young farmer being told by a consultant to use urea…I want that young farmer to be skilled enough, schooled up enough to say no to that consultant for these reasons…But you see, these young ones want to be empowered with that option…Lincoln are guilty…How come they're spitting out the same sort of results from students? It's ridiculous...[If] you come into dairy farming [after being taught at Lincoln], you come in with a urea understanding." (L, biological farmers, Southland)

Two biological participants (O and B) further mentioned that dairy consultants, sales representatives and other officials have all "learned the same song". Participant B said that these industry representatives have all been cast in the same mould having often been educated in the same places and trained by the companies they represent. Participant O also said that he met resistance from other farmers when trying to include soil biology in class teaching materials for ITO courses[6]. He explained that many at that institution believed that urea was the only way to grow grass, because that is what they have been taught and believe.

Universities and research institutes in New Zealand such as Landcare Research, DairyNZ, and AgResearch provide farmers with results from field and laboratory trials that are often designed to help them in their choice of practices. The dissemination of their findings in the agricultural community have sometimes had a clear influence over participants' thinking and decision-making.

"We know what we have to do through DairyNZ who do a little bit of science…the trial work would say: we do this, this will happen. And sure enough, that's what we did, and that's what happened, we had a very good season...Science has already been done. Let's do it. (J2, conventional farmer, North Island)

[6] Primary ITO is a non-profit educational institution that offers courses within all primary industries focused on applied learning.

There are, however, participants who were sceptical of how research is being conducted and by whom.

> *"Research is all about protecting the status quo and enhancing the status quo rather than actually looking at alternatives. True alternatives, [rather] than actually just continuing to intensify and trying to drive it harder and harder when we're actually at a point where we can't drive it harder." (L2, conventional farmer, Southland)*

Participant B, who runs a biological operation in Canterbury, similarly said that national and international research done today only exists to maintain the status quo and to market agribusiness' own products. He recited a quote from researchers in the United States of America that he felt rang true in Aotearoa New Zealand as well: "Give me $100 000 and I'll give you the answers that you want to hear". He was making the point that he feels that research funders often shape what is researched by directing funds to research that is related to products and services that they can sell.

It all seems to come down to trust in the information received. Scientists in Aotearoa New Zealand are generally trusted to a similar degree to that of other farmers and farmers' forums by farmers (Small et al. 2015). This was reflected in the value that many participants placed in peer-reviewed research and the lack of trust they had in anecdotal evidence.

> *"I like science. Not anecdotal evidence. Anecdotal evidence is what they [agroecological practitioners] always say." (H2, conventional farmer, North Island)*

> *"Biological, yeah, I'm not convinced of that one although some people swear by it because there is a lot of anecdotal evidence…There are so many variables… So, you've got to do some trials and then peer-reviewed and come to some sort of conclusion. We've got all that with artificial fertiliser. We've got all that peer-reviewed from God knows how many years of it. So, we stick to that." (D2, conventional farmer, Canterbury)*

When asked about agroecological approaches to farming, some conventional participants were critical of them due to the perceived lack of peer-reviewed science and research. Conversely, many agroecological participants were critical of conventional farmers' trust in sales representatives.

> *Daughter: "[Farmers] basically put all their trust in their fertiliser company and whatever they say is exactly what they do, and they don't [question it]. They may second guess it, but they don't know what else to do so you do it anyway." (I, organic farmers, North Island)*

Some went further and felt that industry bodies and advertising have pushed farmers into adopting certain practices or a certain system that farmers do not necessarily benefit from.

> *"I guess that probably a lot of people that go biological start just looking into things more in depth and questioning why they're doing certain things that they're doing. And a lot of the answers are only because we've been pushed into it by DairyNZ or by advertising…then you start thinking 'Well, why are we actually doing it?' and a lot of the times it's just someone is making money out of it pretty much. And it doesn't tend to be the farmer." (G, organic farmer, North Island)*

> *"You could argue that the DairyNZ model has gotten us into, not all the trouble, but a considerable amount of the environmental trouble that we're having around grass-based which is very protein-rich which increases your nitrates, cows out on the pasture all year round which there again, lots of urine spots which create nutrient leaching issues. Perhaps more work on the biological, once-a-day or organic or big…feedpads, that sort of thing, if they'd done that earlier, could've provided more options instead of being so focussed on this one model." (F2, conventional farmer, Canterbury)*

> *"I think there has to be a realisation that the metrics that they've [DairyNZ] used…give no allowance…for staff satisfaction or animal welfare. The metrics might have been alright in the past and they've driven production which has driven capital gain…they have been trying to drive this status quo whereas a vast percentage of farmers are starting to say now that the status quo is not enough…they want more than just the same message." (L2, conventional farmer, Southland)*

These participants call for an improvement in direction and in the leaders within DairyNZ because they feel that the model that has been promoted is not representing where some farmers want to go in the future. Due to the influence that DairyNZ has in New Zealand, some participants believe that DairyNZ could do a much better job furthering knowledge in alternative areas.

The participants' testimonies suggest that education and research can influence knowledge acquisition and evaluation among farmers. How they use the knowledge differs depending on past and present experience and practices, as well as on the extent of trust held in the knowledge provider. In some cases, individual research on different practices and production systems outside of education and magazines or forums that disseminate research can make a difference to decision-making.

"There is organic by neglect and then there's organic guys who are doing it properly and doing it really well. It's the organic by neglect that sort of everyone sees and it's what puts you off. And put me off as well. I guess, as I've started looking into it a bit harder and harder, a lot of the things they talk about actually make a lot of sense and it's not as crazy as you sort of think to start with. As I did more research, it seems to make a lot more sense." (H, biological farmer, North Island)

External knowledge, which is both laid down early in life and acquired throughout life, thus seems to influence the path and practices that participants choose as well as beliefs and attitudes towards certain practices. This is likely related to social norms because what is taught and researched in mainstream institutions more easily becomes "what everybody is doing". Social connectedness is also likely related and will be discussed in the following section. The interactions between these external, inter- and intrapersonal factors is evident and adds support for their inclusion in a model on decision-making as a factor influencing threat and coping appraisal.

5.3.2 Social connectedness

Many participants explained how accessing information and inspiration from people outside their normal social network, both in and outside farming circles, had a significant impact on their understanding of where the dairy industry was heading. This has an influence on perceived vulnerability and severity of potential threats and whether potential opportunities could arise by changing practices or production system on farm. Examples of groups mentioned by participants were Federated Farmers[7], DairyNZ's Dairy Environment Leaders Group[8], and local discussion days[9], where they can interact with either government Ministers, the community, or local dairy farmers depending on the group they belong to. Analysing the knowledge gained through these interactions has enabled some participants to make changes to their farming systems, such as converting to organic production.

Husband: "That's where the whole thing is tied in with [Federated Farmers] and getting exposure to a lot of really interesting people, very smart people. I'm not talking about other farmers around New Zealand. I'm talking about some of the really good speakers...It's Nathan

[7] Federated Farmers is New Zealand's leading rural advocacy group whose aim is to give farmers a voice at a national and provincial level (Federated Farmers of New Zealand, 2019). Anyone can pay to become a member and provincial presidents get voted in by local membership to an unpaid position.

[8] Dairy Environment Leaders are farmers who, at a local level, engage with their communities to achieve better outcomes for the environment and farming through different initiatives (DairyNZ, 2019b).

[9] Advertised on DairyNZ's website, discussion days are more informal meetings, often on farm, between farmers and agri-business professionals where the topics of discussion can be diverse (e.g. the benefits of winter milking, organic conversion processes, or reproduction rates) (DairyNZ, 2019d).

Guy, the associate Minister of Agriculture and all these sorts of people. You know, over a beer. They'll come and speak at your conference, and then they'll come for social hour after that. That's where you make the most progress, just standing with a beer in your hand just talking to these people socially. And it's those sorts of environments that I've sort of really gained the most in where things are going and what we need to be doing and 'What are you thinking?' you know. That's really how we've come to where we've come." (K, organic farmers, Otago)

Through the same organisation, another participant explains how being involved in the group has made it easier to understand the adaptations he needs to make to meet incoming regulations.

"One of the good things about being involved in these industry groups [Federated Farmers] [is] that you can use it for your own purposes [laughter]. I question them about this, and 'What do you think about that?' and trying to get perspectives… I've been involved in these industry groups because you do get a bit of foresight. You get to see it all early, and I've got a better understanding of what it would take to meet some of these new regulations." (F2, conventional farmer, Canterbury)

At a more local level, another participant is taking a more hands-on approach together with other farmers to look at how they might transform their systems to meet the demands and pressures of the future through their local catchment group.

"I'm part of helping set up a local catchment group…And in that space, I'm also involved with DairyNZ with Dairy Environment Leaders Group. A number of us are already thinking about what our production systems may look like going forward. We haven't got a recipe yet [laughter] but we are endeavouring to embrace change and think about what change might start to look like." (L2, conventional farmer, Southland)

Across the country, there are a number of discussion days organised during which farmers can connect with their neighbours and colleagues more informally. For one participant, this creates an opportunity to listen and see what other farmers in their area were doing and get ideas.

"Discussion days are really a good point to see whatever everybody's thinking about, what they're trying about, and see what they think is suitable for them." (O2, conventional farmer, Canterbury)

Being part of a network or group and being able to bounce ideas and share experiences is clearly very important for these participants, regardless of whether it is at a national, regional, or local level, especially in a time when they are experiencing different kinds of pressures in the industry with regulations, public perception and changing consumer trends. This also highlights the

interactions of social connectedness with other influential factors in the conceptual framework, such as external knowledge. These and other factors have a clear influence on threat appraisal.

When changing production system or practices, it is important to have mentors that can support the transition with knowledge, experience, and encouragement. Being one of the first people in an area to do something new, such as converting to organics, can be challenging. In such times, the ability to reach out to other people who have experience of that production system becomes very important for both emotional and informational support.

> *Wife: [Organics] is still very new down here…we're just getting going so it's making those networks. Luckily, we've got [an organic farmer] and his wife in there. They've obviously been going down this path for many years, and they've been very free with their knowledge. I think if maybe they hadn't been around and done what they did, it would have been a lot harder." (K, organic farmers, Otago)*

Another participant relied on his independent consultant to guide his transition to biological production after being introduced to biological fertilisers a few years prior by a fertiliser representative.

> *"There are other ways of doing things. I guess that [seeing good results from trials with biological fertilisers and independent research] has led on to word of mouth, and then meeting [consultant]. I guess [he's] pretty much been coaching me or telling me a lot of stuff on alternative ways of doing things and stuff like that." (H, biological farmer, North Island)*

Social networks are very important and can act as support during a transition to a new system. Thoughts and worries about what their neighbours and colleagues might think about them may act as a barrier to adoption, which will be further discussed in Section 5.3.9 about norms. If norms can act as barriers to adoption, social connectedness can act as enablers giving the confidence to change, which is part of coping appraisal in the conceptual framework related to self-efficacy.

Agroecological participants indicated that they worried about the thoughts of other farmers prior to converting their systems, but that they have been pleasantly surprised by their conventional counterparts.

> *Husband: "I think when we first said that we're doing it [organics], it was a bit of a joke…But it's actually quite interesting now, with things that have happened in the industry. I've had people saying to me 'I can see why you did what you did' and… 'We're really watching to see how that goes'." (K, organic farmers, Otago)*

"I was expecting a lot of people giving me a bit of stick about it, going organic; but it is amazing how many people want to know what we're doing and how we're doing it and everything like that…They look over the fence, and they've said to me 'Well, what are you putting on your place because it looks better than my place?'." (G, organic farmer, North Island)

Social connectedness can be very important, perhaps especially for farmers, as they tend to live further away from their neighbours than is typical among urban populations in Aotearoa New Zealand. Many participants perceive a negative media bias and negative public perception, as described in Section 2.1.4. Together with pressure from incoming regulations, some participants report becoming a more cohesive group, stating that they currently only socialise with other dairy farmers in order to avoid negative comments from non-farmers. As part of social networks and official groups, some participants also outlined how they try and encourage change among their peers in the face of new regulations because they are all affected and need to improve collectively to meet the requirements.

"A lot of the work that I've been working on is around trying to change famers' perceptions. When new regulation comes in, how do you try and get farmers on board with that as quickly as possible. Because up until rather recently, what my neighbour did, didn't really impact me. He could be a good farmer. He could be a bad farmer. It didn't impact what I was doing. With the new environmental regulations, it really does. If my neighbour doesn't lift their game, then we'll all get punished… The regulations hit everyone equally, and so it is in my interest as a farmer to have all my other neighbours farming at a better standard, because it means that it's going to be better for all of us going forward. That's sort of one of the challenges that I've found, getting farmers over that mentality that what you're doing on your farm doesn't just affect you anymore. It's going to affect everybody, the whole industry." (F2, conventional farmer, Canterbury)

Community feeling is important as the sense of belonging and feeling accepted are elements of wellbeing, which may also influence an individual's decision-making. As the example below will show, this can be an advantage when trying to make change happen at a local level. Approaching another farmer in a friendly way offering support, knowledge and camaraderie can, in cases such as these, lead to improved outcomes on the land due to the connections and trust established among peers.

"If someone sees something that is not right, they can call the pod leader [leader of a local group whose aim is to deal with erosion on farm] and together as farmers we can drive up

the driveway to talk to another farmer to solve their problem…that's where we come together as a farming community…It is really based on people willing to do it. I believe people generally want to do the right thing. But if they don't know what the wrong thing is, they can't focus on doing the right thing. So, there is a fair bit of education to go, but farmers listen to farmers, they don't listen to teachers." (A2, conventional farmer, Otago)

In the interviews, participants stated that farmers are doing a lot of things to comply with regulation and adapt to other pressures in society and in the industry. Many were part of networks and social groups to be able to access information or help influence other farmers to change their practices. The exposure to different people from different sectors sharing their thoughts has influenced some of the participants' decision-making considerably. It also seems that being able to connect with other practitioners and consultants, who have experience with operating the future production system of choice, makes the adoption of those practices and the transition much easier. Some of the participants mentioned belonging to existing groups to try and help each other overcome issues such as compliance or to understand the trends in dairy farming. Social connectedness appears, therefore, to be an influential factor in decision-making that can help inform how threats to and opportunities in the industry are perceived. This is likely to also have an impact on the perception of response efficacy and, hence, the relative advantage of changing practices.

5.3.3 Observational learning

In their discussion of the factors that facilitated change of practices, many participants identified the value of having observed other farmers who were already using the practices. Observational learning is a way of gaining experience and confidence in adopting new practices or production systems. For this reason, observational learning is included under influential factors acting on threat and coping appraisal in the conceptual framework. The influence of demonstration and observation in the participants' response is similar to that identified by Pannell et al. (2006) and Small et al. (2015). Reading or hearing about different practices is not the same as seeing with your own eyes how something works on someone else's farm. This was very evident in the interviews in which participants reported the importance of being able to ask fellow farmers questions about their practices and setting those in relation to their own farm to see if there was a relative advantage for them in changing practices. This was seen as extremely important for gaining the confidence and self-efficacy to change practices on farm for all groups of participants.

"It was probably through neighbours and also [son] as the main driver. Because he sort of knew people that were doing it and started making the initial contact." (D, biological farmer, Canterbury)

Husband: "Throughout my time banking, the people who consistently made the most money, did the best financially, where the low input systems. So that's kind of what's guided us into the system we were in before we went organic." (K, organic farmers, Otago)

"There's been a local guy down the road in [place name]. He's just been signed up to be organic so it'll be interesting watching that." (G2, conventional farmer, North Island)

"I need to feel and those sort of things. If it works, I'll do it and see what happens [laughter]. If it works, I'm into it but if it doesn't…Like palm kernel, I wasn't into that in the early days either. I just watched a few guys and tried it out." (J2, conventional farmer, North Island)

"To be fair, in order for me to make a real judgement on it [biological milk production], I'd need to go and see someone…who has been doing it for 10-15 years and see that it is repeatable annually and that they are profitable and that there are actual benefits from doing it." (N2, conventional farmer, Southland)

The quotes above highlight the importance of seeing the successes and failures of other farmers to decide on whether or not to try something new themselves. Other farmers' approval also increases the confidence to try it yourself and that it is a worthwhile venture, which directly influences self-efficacy of coping appraisal.

For some of the participants in this study, a long period of exposure was important for large-scale decisions to be made:

"I did have a friend who was farming biologically…for four or five years before we [went organic]. He's been using the odd little bit of urea and a few other bits and pieces, but had cut out all the phosphates and was using more natural fertilisers and stuff like that, and was getting good results. Well, we thought if he could do it, then surely we can as well." (G, organic farmer, North Island)

Self-efficacy and perceived behavioural control really come to the fore when looking at observational learning and prior experience. Not only are these important in feeling that the new practice or production system has a relative advantage in comparison to their current system, they are also necessary in building the confidence required to cope with the change.

5.3.4 Prior experience

Experience seems to be very important when making a decision on how best to design your farm system and influences self-efficacy. As such, it was placed among the other influential factors acting on threat and coping appraisal in the conceptual framework. Most farming practices are taught in

younger years, either through learning provided by family members, peers, employers or educational institutions. In some cases, it was evident that the practices employed on farm had been in place before the current farmer took over the managing position.

> *"[I] suppose it would be classed as reasonably large land area, but small number of cows, so lower stocking rate. With an attached runoff that also farms sheep. We split calve so two thirds calve in the spring and one third calve in the autumn. How that's come about it's because that's how it's always been, I suppose." (I2, conventional farmer, North Island)*

> *"I guess we've always been a number 1, number 2 system[10]. Pretty much all grass but young stock generally grazed off...Predominately grass through the milking season…I guess, if you ask why we farm like that, that's how I learnt how to farm when I started farming and I think I'm pretty good at that. Why change?" (M, organic farmer, Southland)*

For most people, continuing a tried and proven system that is suitable to your needs is a less risky option than adopting an otherwise unknown system. The belief in your own abilities to operate that system provides comfort because you know what you get, especially if you are new to dairy farming or to managing. This type of experience or mentorship from older siblings or employers is extremely valuable for young farmers who set out to continue the family farm business or set up their own farm elsewhere.

> *"I guess the majority of the system is set up based on what I had experienced on two of the other farms [in this area] that I had worked on that were quite modern…I really just picked a system that I knew well to start with that I guess I saw as being quite sustainable going forward." (F2, conventional farmer, Canterbury)*

> *Wife: "You learn from the people you work for. And also your mentors. My brother's a lot older than me so a lot of what I do is because he does it." (M2, conventional farmers, Southland)*

Learned practices that work or have always worked in the past are hard to change. It is easier to tweak a behaviour or practice and make the system gradually more efficient than to radically redesign the production system all at once, which would require a greater change of mindset. If a farmer is interested in something different, such as a new practice or product, they can build experience and confidence in their abilities (self-efficacy) by trialling it before going all in.

[10] These numbers refer to DairyNZ's classification of five dairy production systems, an outline of which can be found in Section 6.2.2.

"In the last two years, I have trialled a couple of biological things and seen some pretty good results with the soil conditioners and stuff like that. So I guess I feel like it's not that I'm just jumping off a cliff anymore." (H, biological farmer, North Island)

Adopting a practice with which you have no prior experience can be intimidating. Some farmers, however, decided to take the leap despite some concerns.

"We were worried when we first went to the organic system that we weren't going to be able to do it with the animal health. I was worried about all those things, but they all sort of fell into place. It took a while to fall into place, and you had to experience it, to do it really, to get there." (J, organic farmer, North Island)

Despite not being completely certain how animal health could be managed organically, this participant describes that the confidence came with time spent practising the organic system, thus building experience by doing. Experience thus seems especially linked with self-efficacy, which is an integral part of coping appraisal. Having trialled a practice on a small scale builds the confidence to attempt larger scale changes and perhaps cope better with perceived threats. Prior experience might also be a barrier to change and guide an individual to keep doing what they are doing as it is the tried and tested method that has always worked for them. The difference in response might logically lie in the perceived severity and probability of a threat; if there is no perceived need for change, other practices are not likely to be evaluated as options. Conversely, a threat might be perceived but the current practices or production system do not need to be changed in order to cope with the threat.

5.3.5 Personality variables

As discussed in Section 4.1.3, it was only possible within the scope of this thesis to allow participants to self-report personal characteristics rather than asking questions in a form similar to a personality test. During the interviews, participants had opportunities to express whether they were generally keen to try new things, how they respond to risks, and whether this has an influence on which practices or production system they chose.

Many agroecological participants mentioned their inquisitive nature and the willingness to question the status quo. Participant B, who runs a biological operation, said that he sees himself as an uneducated thinker always responsible for his family's income so being inquisitive helped him see new avenues to improve profitability. Other participants mentioned similar sentiments.

Father: "I've always had an interest. I've been able to be sceptical. If everybody is going west, you go east. For some reason, there's a connection between fashionable ideas and failure." (L, biological farmers, Southland)

"I like change and trying different things. It's just me. I hate the mundane, doing the same thing all the time. If you're doing the same thing, you're only going to get the same results as you've always done, and you need to get better results, so how do we find out about that? We try different things." (M, organic farmer, Southland)

"What we are doing now, that is not necessarily the perfect way, and if something else came along [that] we could see works better, we would give it a go. So we are always willing to try different things, and we do a lot of tests and trials with fertiliser guys and that, just to compare their products. We are definitely open to different ideas." (O, biological farmer, Canterbury)

When education, accessible research, and talking to your peers fail to provide an answer to a problem, people may look for information on their own. Researching material online or from books is part of many participants' solution to lacking information.

Father: "I think I've capitalised on it through old book shops. Because if you go back and read pre-1900s [books] on agriculture, you see a pattern…As I said before, I can't handle the wool being pulled over my eyes." (L, biological farmers, Southland)

Even if a person is inquisitive and willing to try new things, there may be barriers to making that change. A farmer's characteristics and level of risk aversion can determine whether they would like to intensify their system by increasing inputs to increase production. A higher level of risk aversion and higher-order goals, such as having a comfortable lifestyle, can make a farmer retain a lower input system that is resilient to changes in the market place.

Wife: "I am not a gambler. You know, I feel the high input systems are gambling a bit because there are all those years that they can't make money….I don't like to gamble. So this system is very safe, very secure. At some stage, our growth is more limited than on other systems, but we're not out to be billionaires. We're out to make a comfortable living, have a comfortable lifestyle and also happy, healthy cows." (M2, conventional farmer, Southland)

From literature review, we know that personality variables affect individuals' decision-making, which is why it was included as an influential factor acting on threat and coping appraisal in the conceptual framework. There is not strong evidence from the interviews that participants regard it as a major variable, however. Interestingly, many do not seem to spontaneously report it, which is possibly a result of the interview questions. The data gathered in this study indicate that personal

characteristics are appropriate to include in a model on decision-making, with the caution that further study would be needed to discern which personality traits are the most prominent when deciding whether or not to adopt different practices or production systems.

5.3.6 Affect

The emotions created by doing or not doing something can also be a driver for behaviour, which is why affect was placed as an influential factor acting on threat and coping appraisal in the conceptual framework. If an individual feels good doing something, chances are higher that they will continue with that behaviour. Equally, if an individual feels bad doing something, they are more likely to stop the behaviour. In the interviews with the farmers, most of the comments relating to affect were centred around the negative public perception of dairy farming and how that made the participants feel.

> *"Sometimes I wish I didn't feel so strongly about things really…I wish I could be more laid back and not mind when Mike Joy[11] comes on television and all people who are constantly attacking us as an industry…I'm sure that people feel attacked…Everyone feels criticised. And it's not a nice [feeling]." (D2, conventional farmer, Canterbury)*

> *"It [bad perception and media] is not helping the farming industry. It's not helping peoples' wellbeing either…Even the younger generations [are] getting pissed off with it. [You] meet people and tell them you're a farmer, and straight away, their face drops." (D, biological farmer, Canterbury)*

> *Wife: "You know, when you look at the money that New Zealand farming has chucked into the environment, into research, into fencing waterways, into plantings. All that sort of stuff, and we're still called dirty dairy farmers, and you're thinking 'what are the other people doing?'." (M2, conventional farmers, Southland)*

Feeling unjustly targeted by the media and by the general public has a clear negative effect on the participants' emotions and reasonably also on their wellbeing. Conventional participants, in particular, mentioned the many mitigating practices that dairy farmers around the country have to adopt in order to reduce the impact of farming on the environment, but that these positive efforts were not being presented by the media.

[11] Mike Joy is a freshwater ecologist and science communicator from Victoria University in New Zealand, who has been vocal in his criticism of dairy farming's impact on the environment.

Organic participants mentioned the good feelings they experience when operating their production system and feel appreciation from other people.

Wife: "It is a good feeling. It is nice to be able to say you're an organic dairy farmer."

Husband: "Yeah, I never introduce myself as a dairy farmer now. I always say I'm an organic dairy farmer. People go 'Really? Oh wow, that's amazing. Awesome, congratulations'." (K, organic farmers, Otago)

"Once you go into the [organic] system, very few people leave. They go in, they like it because it's a different way of farming; it's a challenge; it's got wonderful things in it. And you can grow grass; you can look after your animals pretty well. You know, you can do all those things. It's got its challenges; but it's a really good way to farm. We don't have any bloody antibiotics, there's nothing. And it's so good. It's just such a good way, you know, that way it's good. Environmentally, I think it's pretty good." (J, organic farmer, North Island)

"Morally, I think everyone would like to farm this way [organically] because you do feel a lot better now when what you're producing is not chemically enhanced." (G, organic farmer, North Island)

Another topic that elicited an emotive response was that of environmental regulations potentially forcing farmers to house their cows indoors rather than outside on the pasture.

"I see that [cows in barns] as a bad thing. I'm not farming like that. I've been told by regulators what's going to happen and I'm like 'When that happens, I'm finished. I'm out. I'm not playing that game'. Zero interest in farming like that…I just don't like the intensity of it. I'm a pasture farmer. My whole passion for farming is grass and paddocks." (J2, conventional farmer, North Island)

Many participants did not like the concept of the pastoral system changing to housing cows in barns because this is not how they see themselves as farmers. The negative emotion resulting from the perception that this is a potential future scenario could reinforce the will to continue pastoral farming the way it is currently being practised; participants want to farm in a way they feel comfortable and that suits them, their family, their situation, as well as the New Zealand climate.

"At the moment you see barns and all that going up. To me that's not New Zealand. I mean, it does have its place in certain areas, but I'd hate to see this farm go like that. When Synlait brought this grass-fed [value-added premium] in supplying a certain market, Munchkin, it was

just a no-brainer to go with it because we were already doing that system anyway. Grass." (C2, conventional farmer, Canterbury)

Other feelings of affect expressed by all participants included the enjoyment and passion of being a dairy farmer.

"Being a dairy farmer is amazing." (J2, conventional farmer, North Island)

"We work hard, but….we've got to the position where we're happy." (O, biological farmer, Canterbury)

Only one biological farmer was disillusioned by the difficulties of making ends meet being an independent producer and found it difficult to find positive sides to being a dairy farmer. All other participants expressed either a love of being able to farm in their particular location, the enjoyment of working with animals, or the challenge of operating an efficient system.

The sentiments of affect seem to act more as a barrier to change and be an outcome of operating a certain practice or a specific production system. Affect can thus be a reason to maintain a chosen system once adopted because doing so makes the practitioner feel good. Whether or not it influences threat and coping appraisal is, however, difficult to discern from the interview material. It might instead have an influence on the types of options a farmer evaluates to respond to a perceived threat, which supports its inclusion as an influential factor even if the effect is small based on the findings in this phase of the study.

5.3.7 Values

As described in Section 3.2.7, there are three value orientations (egoistic, altruistic, and biospheric) in the VBN, which relate to the willingness to remove sources of harm and suffering from themselves, other people, or non-human objects such as the environment. If an individual believes they can reduce the perceived threat, the decision to act may be triggered. As such, they have been placed as influential factors acting on threat and coping appraisal in the conceptual framework. All three value orientations appear important to different degrees, as will be discussed below.

Biospheric values

Biospheric value orientations, such as environmental and animal welfare concern, were apparent in interviews with all participants. Many organic participants chose their production system based specifically around protecting the environment and feeling like organic production is "the right way to farm". The following two farmers chose their organic system early in their dairy farming careers. One of them converted from conventional production more than ten years ago, and the other had experience working on an organic farm prior to starting their own business less than five years ago.

"I always thought that organic agriculture was the way that New Zealand should be because it is compatible with protecting the environment, and it mattered to me quite a lot. It was my primary interest in organic agriculture…we wanted to farm organically because we wanted to farm with a lighter footprint environmentally." (A, organic farmer, Canterbury)

"I've always grown organically and biodynamically. There was never a question that it would be anything other than that…The idea that you are putting poison on your land, feels like a really wrong thing to be doing…I really resist that kind of industrial factory farming that we see in those massive dairy farms. For me, it's so important to keep my calves on the cows…I think it is deeply wrong to take them off earlier." (C, organic farmer, Canterbury)

Despite the temporal difference in when they decided to adopt an organic production system, for both farmers, the values underpinning their decisions are similar. The values portrayed are both ethical and personal in the sense of not wanting to operate a system that was incompatible with the participants' values related to the biosphere and animal welfare. For these two farmers, their values seem to have been instrumental in guiding them to adopt the production system they are operating. Another organic participant, who converted a long time ago, explains their moral reasons, both biospheric and altruistic, for choosing their production system:

"I'd probably give up if I had to change from organics…I don't think my conscience would allow me to go back to using chemicals…I just don't think it's good for the environment or for peoples' health...We didn't do it for financial reasons to start with. We did it because morally, we thought that was the right thing to do." (M, organic farmer, Southland)

Biological farmers in this study seem to have been influenced by environmental concern as well. The following participants were influenced to consider different alternatives because of the use of high amounts of synthetic fertiliser and running high stocking rates in conventional systems. In these cases, the value that is placed on a healthy environment has a clear part to play in decision-making.

Husband: "... even if a lot of those organic fertilisers don't work, it makes you feel better."
Interviewer: "Because of the care of the environment?"
Husband: "The environment, yeah…I'm definitely not in favour of just wide-spread urea use. I think that's wrong. So I'm sort of trying to find an alternative that would make less urea work better." (N, biological farmers, Southland)

"We're only running a cow to the acre and I think a lot of farms [out on the Canterbury plains] are up to five…20 years ago you could go out there and there'd be one rabbit and a sheep to

the square mile because there was only river bed and gorse bush and no grass. Now it's all…lush green dairy country. So, if you're going to be farming on that you've got to be feeding the grass something because there is no natural dirt or soil there. I don't think that's good. I think that milk production in New Zealand probably should be halved to save our rivers and things." (E, biological farmer, Canterbury)

Similar values associated with taking care of the land and environment were also apparent amongst conventional farmers. The use of synthetic fertilisers, however, was for many a necessity to improve the land in contrast to most organic and some biological participants. Many conventional participants mentioned "feeding the world" as an overarching goal, which they felt was incompatible with reducing synthetic fertiliser use due to perceived impacts on production levels. There thus seems to be a balancing of social and environmental commitments by some conventional participants.

"For me, the word stewardship is the top of the list, and so with that comes the realisation that you don't own that land. You own the right to occupy it. And with that right comes a great responsibility, to either maintain or improve that land. And so, we are improving it by making it productive to help sustain the human population by making food, but that doesn't give us the right to degrade anything around it." (A2, conventional farmer, Otago)

Being good stewards of the land and leaving the farm in a better state to their children was a common value among participants. The path each farmer takes to improve or maintain that land is highly individual, however. Participant A2 described his family's intention to create an eco-friendly farm, whereby he meant making sure that the design of the farm facilitated minimal runoff to the surrounding streams and improved animal welfare. For many of the agroecological participants, their choice entailed reducing or eliminating synthetic fertilisers. The biospheric values are similar, but the means to uphold them differ among the participants.

Producing own feed or utilising local sources of feed thereby reducing ecological harm elsewhere is a clear biospheric value. An ecological condition that was mentioned consistently by participants was the perceived natural advantage of being able to grow grass throughout most of the year in New Zealand. This was valued by many who opted for a grass-based system due to the lower cost and lower risk involved as well as being better for the environment. Many specifically mentioned

avoiding using palm kernel extract (also abbreviated PK or PKE[12] by participants) because they did not want to contribute to the destruction of the rainforest and habitat for orang-utans.

> *"I think it's just ridiculous that we are shipping stuff in from another country to feed our cows. It just doesn't make any sense to me. I know how it makes economic sense to people but from a purely philosophical point of view it just seems ridiculous…that is why I use barley. It's grown locally. It's got a better nutritional component to it, [is] easy to handle, and doesn't [give me] a guilty conscious over orphaned orang-utans and that sort of stuff." (N2, conventional farmer, Southland)*

> *"We refuse to feed palm kernel, just out of moral basis. Exposure to biosecurity for New Zealand, it is our single biggest risk to agriculture, aside of ourselves. And…I have never been to Indonesia, to see the home of the orang-utan, but when you go on Google Earth and you look at the area that's been smashed and what's left, it does make you gasp a wee bit. So I don't want to be part of that." (A2, conventional farmer, Otago)*

> *"There's lower cost, easier to manage…You've got to think a wee bit more whereas grain feeding is so easy…on grain, PK, that sort of thing, it's easier getting condition on cows a lot sooner. But then, to me, our way is more environment friendly as well. We're using what New Zealand does best [which] is [to] grow grass." (C2, conventional farmer, Canterbury)*

The relative advantage of adopting an all-grass system are reported to be lower cost, using New Zealand's natural advantage, as well as supporting individual biospheric values that, in some cases, led to strong personal norms. The additional management required seems to be outweighed by the perceived rewards. For some participants, feeding primarily grass is seen both as being a more environmentally friendly alternative compared to feeding grain or palm kernel extract, but also as a pathway to increased profitability.

Egoistic and altruistic values

Being able to cultivate a lifestyle where there is time and means to care for family members and reduce stress was important to all participants. All participants seemed to want to create a system where these values could be well upheld. Examples include setting the farm up in trusts so that children could access money when they get older, building a house so that elderly parents would

[12] PKE is a by-product created from producing palm oil in South East Asia. It has been promoted by DairyNZ on the basis of the relatively high metabolizable energy that it contains in relation to its cost, and is described as "a dry, gritty meal with a soapy smell [which] has low palatability until cows get a taste for it" (DairyNZ, 2019e). Due to biosecurity risks, shipments of PKE need to be fumigated and the vapours released off-shore before being used on farms (MPI, 2015).

have a place to live, or managing the farm in a way that maximised time spent with dependent children. Autonomy was consistently mentioned by all participants due to the apparent value it brings to their lives as dairy farmers. Due to its prevalence in the interview material, the impact of autonomy on threat and coping appraisal is described separately in Section 5.3.13.

Enjoying work can be one of the most important goals for people. For some, this can include reducing the amount of stress that comes with all aspects of life, both vocational and personal. As described in Section 2.1.6, high workload, lack of sleep and not enough time for oneself and family and friends are the main factors that negatively impact younger farmers' wellbeing (FARMSTRONG, 2018). It was important for many participants to enjoy the practice of farming and the lifestyle by avoiding stress. The value participants placed on time for self and others has affected their choice of practices and production system in some cases. Many participants clearly explained how intensifying their system was not aligned with these values and how they actively chose a system that did.

> *"If I intensify in order to feed more cows, that means that I'm going to be busier myself and that is not something that I want. That's not an economic driver, that's just a lifestyle driver probably reflecting my age more than anything else and I've also got a young daughter I want to be able to spend time with." (N2, conventional farmer, Southland)*

> *"I've got young kids and stuff, so I thought that wasn't much fun doing that [busy] season. I couldn't carry on like this. I was so stretched for time…I could do it, but if I was doing that, it meant I wasn't doing something else. I was out in the shed at night welding stuff and I wasn't with the kids." (I2, conventional farmer, North Island)*

> *"We're about making some money but also, we have children and we like the lifestyle. The high input farms spend a lot of time running around in circles, chasing their tails and spend little time with their family. So, we are very laid back and have a lot of family time." (M2, conventional farmers, Southland)*

> *Mother: "This whole idea of getting bigger and bigger and bigger and bigger and busier and busier and our kids were starting to grow up and getting out and about more and we just wanted to be able to do that. And we just couldn't. We were just so tied to this busy-ness over here...so we decided 'ah, blow this, we're stepping away'…farming should be fun, and I just was so attracted to that." (I, organic farmers, North Island)*

The pursuit of values connected to lifestyle and improved wellbeing seems to have affected which farming system the participants chose. In many cases, participants across the spectrum avoided the

high-input and high-intensity systems in order to satisfy the goal of being able to spend time with children and enjoy the lifestyle of being a farmer. The specific choice is, however, individual where some participants chose a more agroecological system (participants I), a once-a-day milking system (participant I2) or a low input, grass-based system (participants M2 and N2). This shows that the reasons behind the choice can be similar even though the choice itself differs.

Organic and conventional participants F2, I, and N2 also highlight another important aspect of their choice of practices to employ and how to operate their farm. These participants explained how different goals has increased and decreased in importance with age and situation in life. In many cases, this is related to children as the examples above illustrate. Participants I in the North Island used to farm conventionally but decided to switch to organics because it adhered better to their values around the environment and animal welfare, as well as providing them with a lower input system that allowed them to spend more time with their children. Other participants explained their choice of system through a similar lens based on their situation in life:

> *"There's economic drivers but there's also personal ones and lifestyle ones...All decisions made around production or investments [when I was younger] had that end goal of owning a farm. Now that I am here, I have sort of probably taken my foot off that one a little bit." (N2, conventional farmer, Southland)*

> *"I couldn't have done it with a partner and kids…For the first five years, the farm just absorbs everything…I don't think a family would've survived if I'd have had one during that period…I was in my 20s back then...When you're in your 30s, your perspective changes a wee bit. You can put everything into a business and create something but even if it works really well and you end up with the money and everything that you wanted…money isn't everything." (F2, conventional farmer, Canterbury)*

Working extremely hard and pushing production hard, for example by maximising inputs to create the largest amount of milksolids possible, is one avenue a younger person may take to reach their financial goals. With time, however, situations change and time spent with family becomes more important, which may influence the path taken from there. Perhaps being financially secure was a core value and starting a family was lower down the list of priorities at a younger age.

Situation in life, which was often related to time, is, therefore, an important factor to consider in understanding farmer decision-making. The practices previously employed on a farm might differ from current practices simply because of the fact that the farmer's situation and priorities have changed with passing time. The interaction between situation in life, age, and values and goals is

evident. As described above, values are an important part of life and can help guide people when choosing to adopt or maintain certain management practices. The values found in the qualitative data and presented here were both biospheric (environmental and animal welfare concerns), and altruistic and egoistic (valuing good quality of life and time with family). Other altruistic values mentioned in the interviews but not described in detail here were those of creating a comfortable workplace for staff. This was found among all three groups of participants but was not found to have a direct influence over the choice of production system. Based on this analysis, values have a clear part to play in decision-making when deciding on which production system to employ, and need to be taken into account as influences on the main decision-making processes of farmers.

5.3.8 Beliefs and attitudes

A relative advantage needs to be perceived prior to changing a practice or production system and also to maintain the current practices or system (Pannell et al., 2006). How people view the world and how they evaluate different practices can have a large impact on this perception. As described in Chapter 3, beliefs are intertwined with the four cognitive mediating processes of the PMT (e.g. beliefs around the probability of an event happening and how severe it will be (vulnerability and severity), beliefs around the expected outcome of the alternative behaviour (response efficacy), and beliefs around the confidence to act (self-efficacy)). Attitudes represent an evaluation of whether the belief is positive, negative or neutral. The following sections will outline the participants' beliefs in four areas that were the most evident in the interview material.

Profitability and environmental regulation

Some participants expressed concerns over increasing land prices and debt levels, and how this might have an impact on profitability. How vulnerable these participants felt they, and their peers, were to these threats, and how severely dairy farmers might be affected by them, was a common discussion point. Being profitable is essential for any business, and especially so if the business needs to service debt. As explained in Section 2.1.5., dairy farmers in Aotearoa New Zealand are heavily indebted, which may create additional pressure on the farmer. The participants who were in equity partnerships, had significant loans to pay back to the bank, or were paying off shares in Fonterra, certainly mentioned the strain this puts on the need to perform and how they felt pushed to increase production and work harder to satisfy stakeholders. As long as a business is profitable, it may continue to operate and perhaps expand. Many participants believe that the model of intensification is bound to change due to mounting environmental issues and regulation associated with them. Some participants expressed that profitability in dairy farming has declined to such an extent that they believe new ways of creating value are needed, beyond increasing production and capital gain.

"Most of the value that people have realised over the last bloody 100 years has been through capital gain, around not just the increase in value of land as it stands but in the development of land…We're sort of at that ceiling now, where we can't go any further really at this point. I think we have some of the most expensive land in the world at present...For farmers, it's about …how they create value going forward and that's a really big question to be fair because it's a hell of a lot different to the way we have created value in the past." (L2, conventional farmer, Southland)

"Dairy farmers don't make much money. They make maybe 3% return on asset…So, profitability is really low. Debt is really, really high. Land prices really, really high. And what's going to happen over the horizon is we've got an increased environmental pressure so they're going to have to…find some massive innovation that is going to enable them to farm with the same level of production but with reduced impacts. And that's both from an environmental perspective and an animal welfare perspective." (F, biological farmer, Canterbury)

"The model that has really worked for dairy farmers for the last probably 20 or 30 years has worked well because the conditions by and large haven't changed…The business model that most farmers run…is more or less: the farm pays the rent on the land so covers the cost of the interest payments, provides you with a bit of an income, and not much more. All your wealth gain came from the increased value in the land. That worked for about 20 years. Now because of the environmental issues that we're coming up against, I don't think that model is likely anymore." (F2, conventional farmer, Canterbury)

The changing conditions that the two latter participants mention are directly related to the perception that environmental regulation has become and will increase in the future. Other changing conditions, such as public perception and consumer trends, will be covered in later sections but are also important shifts that are happening in society. The biological farmer quoted above chose his production system based on the belief that a high-input, high-output model is no longer feasible due to increasing environmental regulation and changing consumer preferences. In response to his belief on the vulnerability of such systems (part of threat appraisal), he set out to independently produce milk that consumers wanted.

"A sector of the public [was] saying they wanted a sustainable and ethical dairy product. So we really looked at that and decided to work backwards and provide that sector of the market with what they were after. That's really why we do it. I mean, we obviously agree with it and we like doing what we do, but the primary reason was that we could see an economic case for a niche market." (F, biological farmer, Canterbury)

Diversifying the farm business was another option chosen by participants in all three groups to improve profitability. Increasing the number of income streams was perceived to increase flexibility and profitability while becoming more resilient to milk price fluctuations. Risk could be mitigated by simply not putting all eggs in one basket.

> *"So what does it look like going forward?...My son…[has] started farmstays through Air BnB…We're starting down the road with bees…because we have opportunities around with the native bush….Also our business focus has come off producing more and more milk…to create a more sustainable business. It isn't just…around risk. Some of it's around environmental risk but there's a whole raft of stuff that falls into that. Helping to mitigate footprint and all the rest of it." (L2, conventional farmer, Southland)*

There are many explanations associated with profitability for adopting changes in the farming system. One of the participants cited above decided to choose an agroecological production system while the other chose to diversify his business, partly because the consumers demand greater attention to animal welfare and partly because of a perceived future increase in environmental regulations. Other ways of improving profitability included increasing efficiencies by moving to an all-grass, self-contained system, cutting costs by switching to once-a-day milking thereby reducing labour costs, and finding higher-value markets for A2, grass-fed or organic milk products. Some participants opted for a combination. The options that farmers can choose from to increase profitability and avoid major ramifications from environmental regulation are diverse. Their choice will ultimately depend on the farmer's belief and attitude regarding the expected outcome of the alternative option (response efficacy), and their confidence in implementing it (self-efficacy).

Consumer trends and public perception

Farmers' decision-making is also influenced by their beliefs regarding where the market is heading, perceived threats to the profitability of the current production model and how the international market influences the milk price received here. Adding value through producing A2 or organic milk products was mentioned by both conventional and agroecological participants as a way to uphold a positive image overseas, thereby securing and maintaining export relationships with consumers who associate New Zealand products with a 'clean and green' image. These are examples of response efficacy, the belief that the different option or strategy will lead to improved outcomes.

> *"I believe that we need to get into more like organic, A2… New Zealand has a wonderful farming image overseas, but we NEED to make that a little bit more unique. And I would SO like to see probably organic or A2. I think New Zealand has to be something different…I think it's where New Zealand should go to." (K2, conventional farmer, Otago)*

"We are breeding towards A2 purely because I think A2 demand is going to get higher. It's just a personal thing…We've got another company that sells raw milk at the gate. We got another shed to milk them in. We sort of pull some cows out of the herd and milk them through the shed to supply the fresh milk. A lot of people ask for A2 so that's why we're breeding towards A2 at the moment." (E, biological farmer, Canterbury)

Daughter: "It's the future: A2, polled, once-a-day." (L, biological farmers, Southland)

Irrespective of the option that participants choose, they appear to be of a consensus that simply increasing production is not necessarily the key to increasing profitability. These participants show that the practices they either have chosen already, are intending to pursue, or in general think would be good for Aotearoa New Zealand, are influenced by where they see an opportunity for the market now and in the future. Though many participants, both conventional and agroecological, see a future market for organic milk production, some conventional participants are cautious and believe that the market could crash if too many dairy farmers started producing organic milk.

Husband: "If everyone went organic…You'd flood the market with organic milk, and you'd crash it. So, it actually needs to be a unique supply to keep organic where it is." (M2, conventional farmers, Southland)

For these conventional farmers, converting to organic production in search of increased profitability is not seen as an option because the expected outcome is believed to be negative in comparison to their current system. The response efficacy is, therefore, perceived to be low. These beliefs have an impact on their decision to stay conventional, just as other participants' beliefs guide them in other directions.

Although the financial side of farming is often highlighted as a major driver for farmer behaviour, farmers are also affected by changing social attitudes. Changing social attitudes may also have an influence on decision-making, and perhaps more so than financial factors. Environmental and animal welfare awareness among the general public is changing consumer demands, as described in Section 2.1.3. These changes could increase the belief that farmers' current system is vulnerable and that the impact is going to be severe enough (threat appraisal) that it becomes essential to look at other options.

"I guess it's a whole lot of things I'm looking at, at the moment, because of the fork in the road or whatever you want to call it that just makes you think that 'well, going forward, how can I make it better for me, my staff, the animals at the same time?'. And really, I guess there

is a huge public pressure now as well on making it more sustainable and environmentally friendly and things like that." (H, biological farmer, North Island)

One example where there was a difference between those who have adopted a more agroecological approach in recent times and most conventional participants was the difference in perception about whether synthetic and alternative milk products would become a threat to the dairy industry. It is important to note that synthetic milk products are currently not available on the market, and, hence, farmers can only speculate about the consumers' willingness to buy such products in the future. Alternative milk products made from rice, oats, soy, and nuts, however, do exist. The difference in perception influenced participants' thinking about whether a change to their system was necessary.

Husband: "We're stoked that we are doing it [organics] now because it's proving to be the right thing to have done…The world has changed, and that's what people are actually wanting and are prepared to pay a premium for…it's more of the marketing and more of the future-proofing of the farm really. And another key thing too with the emerging market of synthetics and lab-grown and all that sort of stuff. I've got some pretty staunch views on where I see things going, and I think that you're going to see two markets. You're going to see the cheap…synthetic type products…We cannot be in that market because we will simply not compete." (K, organic farmers, Otago)

Husband: "I reckon [synthetic milk] will become a fairly major thing. I do because…there are people out there who don't like animals being farmed…So, therefore, if they can get their milk from another source, I think they'd be quite happy…Yeah, I think it will be a reasonable threat in a few years' time, but if we can offer a premium product, we can probably get into markets that that won't ever get to. That's probably the best bet." (N, biological farmers, Southland)

Many agroecological participants mentioned that being more "clean and green" and producing milk in a more sustainable fashion might be what New Zealand dairy farmers need to do to maintain their marketing advantage. The rise of synthetic and alternative milks, as well as the perception among farmers that the urban population thinks that farming is "bad", is seen by some as a potential threat to the industry, where consumers may change their purchasing behaviour.

"And then we've also got increased alternative products from I suppose the synthetic type milks, whether you are talking the fermented milks or you've got your nut milks and all those sorts of things. So the next generation of people are much more conscious of animal welfare and things. [There will be] a lot more vegans making a vegan choice so consumption in the

West is going to go down I think, of dairy products." (F, biological farmer, Canterbury)

Two conventional farmers echoed these sentiments. Both perceive the synthetic milk market to be a threat and that the conventional dairy industry has to change to be able to compete with it.

"[Synthetic milk] won't wipe the real thing out altogether, but it will replace a significant part of the market and I don't think New Zealand is well placed in my mind. Some of our share might be at risk…So unless we can come up with a better story which would help our product compete, we'd be in real trouble and I'm not sure if we're in a position to do that yet." (F2, conventional farmer, Canterbury)

"We have to start moving to as much as we can to carbon neutral and nutrient neutral…Once you get into that space, then you can hold on to value…Once we start competing significantly with synthetic proteins…we're going to actually have to produce in a way that our consumers want to buy our product...if synthetics are cheaper, [and a] more viable option…then regardless of how cheap we produce, we won't be cheap enough to match it." (L2, conventional farmer, Southland)

By contrast, most other conventional participants expressed great faith in the future of conventional dairy products. They are likewise aware of the emerging market for synthetic and alternative milks, but do not perceive it to be an imminent threat.

"Soy milk, yeah. That sort of thing coming on the market, but I think it will never replace it [cow's milk]…it's so many things made out of milk, that it's always going to be a future." (C2, conventional farmer, Canterbury)

"[What] is getting a lot of attention now, and that is going to be an issue in the future, is the protein substitutes, lab milk and lab meat and that sort of stuff. Whether that becomes a threat, I'm not sure. That is something that we have to monitor." (N2, conventional farmer, Southland)

"I think [dairy farming has] got a great future. People seem to like milk, cheese and dairy products. They like everything…so there's going to be more demand in the next 20 or 30 years...[Synthetic products are] definitely a threat but I don't see that coming down the road that quickly. I think we have time to respond." (J2, conventional farmer, North Island)

These data suggest that there is a difference in perceived severity of the threat of synthetic products and consumer trends that is tied to beliefs and attitudes. Allowing respondents to rate their concerns is therefore appropriate to include in the web questionnaire and will be described in more

detail in Section 5.4. The perception of a threat is evaluated against the farmer's business, and a decision is made whether or not to move to a system that they perceive to be more sustainable or resilient. Conversely, if the farmer decides that the threat is not so severe, they might monitor the situation further and maintain their current production system in the meantime. Similar monitoring of potential changes in the market was also found among agroecological farmers, who are, or used to, sell raw milk independently. Due to the close connection between producer and customer, they were keenly aware of shifting consumer trends. One example was consumers' increasing aversion to plastic packaging, which led three participants into considering using glass bottles instead. The reason behind this was the same as for the synthetic milk example: "the consumer is increasingly demanding a more sustainable product and therefore we, as the producer, will future-proof our business by giving them what they want".

Shifting consumer trends and willingness to purchase alternative or synthetic milk products can be tied to a change in public perception of dairy farming. Many participants perceived that consumer trends might decrease the demand for mainstream dairy products unless New Zealand dairy retains a point of difference and lives up to the image of being 'clean and green'. Participants frequently mentioned that the public perception of dairy farming was negative, even though this might not necessarily align with 'reality', as discussed in Section 2.1.4. Beliefs and perceptions, not objective truth, are, however, what influences individual decision-making. Participants expressed that media are not providing a true picture of the effects of dairy farming, which is fuelling the negative perception. Conventional participants mentioned this more frequently than agroecological participants and said that the negative perception could make it difficult to promote dairy products as premium products. This was seen by some as a threat to the dairy industry in terms of a potential decrease in market share. Some participants respond to that threat by adopting an agroecological production system such as organic, moving to an all-grass system, or eliminate the use of palm kernel – systems that they believe consumers will favour in the future.

> *"If we're going to retain our consumer, then our point of difference is going to be grass-fed, and trust in how we produce our product. I don't think palm kernel probably fits within that model. We don't use lots and lots of it, but it will be something that I think we probably need to look at. We will NEED to transition out of." (L2, conventional farmer, Southland)*

Industry standards

Apart from changing consumer trends, there are also potential changes to industry standards that influenced some participants' attitudes and decision-making. Industry bodies or dairy companies may change their standards in response to anticipated consumer demands or external influences,

which may result in a form of regulation that farmers need to adhere to in order to continue to be accepted as a milk supplier. One participant was actively reducing their use of antibiotics acting on advice and indications from their veterinarians, who suggested that it is likely to become part of industry standards in the future.

> *"We had a meeting [with the vets], and they said the way of the future is: you [are] going to have to change because you can't use a lot of these drugs that are very similar to what's used on humans...We sort of thought, 'Right, if that's going to be the case, let's start looking at the cows to cull that are high [in somatic cell count]…. Let's try and get our herd down into a system that's actually less reliant on having treatments'." (O2, conventional farmer, Canterbury)*

Another participant was also reducing his use of antibiotics substantially due to changes in practices in Europe where consumer preference has influenced industry standards. Keeping an ear to the ground and adapting early can be seen a way to improve system resilience in the face of potential future threats.

> *"I'm no organic guy or anything like that but I have just SLASHED the amount of penicillin we've used in the last year. I'm talking, we've probably cut it by 90%...I could see the writing on the wall for dry cow therapy and penicillin. The noise from the EU and that is saying that 'blanket dry cows and heaps of use of penicillin is just getting into the food chain'. I can just see there's a small problem over there and it's coming closer to us, so I might as well just get ahead of it." (I2, conventional farmer, North Island)*

These conventional farmers became aware that antibiotics use is being reduced elsewhere or is likely to become part of enforceable standards in the future. They responded to this threat by changing their practices to accommodate a future in which they are not able to use antibiotics to the same extent as they previously have done. This way, they believe their transition will be less stressful compared to their peers the day the industry starts demanding such change. For them, the probability that there will be changes to industry standards and that it would affect them is perceived to be high (threat appraisal) but they also found that they had the perceived behavioural control and self-efficacy to respond to the threat now (coping appraisal). For one participant, this also presented a reason to convert the business to organic production.

> *Husband: "The vets are quite worried. They can see the writing on the wall with a lot of this stuff as well. And the market is not going to buy all these antibiotics and drugs in the future…A lot of the things that we are doing under organic is going to happen under standard stuff anyway, which is another reason why we wanted to go organic." (K, organic farmers, Otago)*

A similar thing could also be observed with the use of palm kernel extract as feed for cows. Five conventional and two agroecological participants mentioned that they had eliminated or were thinking about reducing their use of palm kernel due to its use not being aligned with their vision of how New Zealand farming should operate. Public perception around its use as well as consumer trends were also major factors. Participants M2 also mentioned that it is not known what negative animal health effects the feeding of palm kernel present, and that it is, therefore, better to minimise the use of it. In terms of changing industry standards, participant F2 mentioned that Fonterra now restricts the use of palm kernel due to its impact on milk quality. Many, however, mentioned that it was hard to reduce the use purely due to the financial advantage of the feed being so much cheaper than other feed sources. This is a clear barrier that may also form part of facilitating conditions, which is described in Section 5.3.10.

Agroecological production systems

Opinions differed widely among participants as to the practicality and value of the different agroecological approaches. This is likely to have an influence on the perception of whether these options present viable alternatives to conventional systems (response efficacy). Their thoughts on what organic or biological farming systems entail and the practices employed also differed widely. Some conventional participants argued that agroecological systems are not that different from conventional systems.

> *"If you really dig down and ask what they're doing, they're conventional farming but stick a bag of pixie dust [on], and they say 'well, we're biological'…Well, they say it, and they believe they are. And they probably are. But they're probably not doing it a lot different. They just say 'Ah, because I spray my fertiliser on with some water and some humates, it's biological'. Whereas I might just…put on my super. It's probably 98% the same as what they are putting on." (I2, conventional farmer, North Island)*

> *"Ah, I don't think much of [agroecological approaches]…In my mind, they're just exactly the same as what I do, with different fertiliser and different animal health prevention and remedies." (J2, conventional farmer, North Island)*

Farmers, who do not identify as biological themselves, may find it hard to understand the principles that govern that particular system, since there is no official definition of biological production systems. This is not surprising and is likely to be an issue for the organic production system as well. Even though organic systems are clearly defined by international certification governing bodies such as IFOAM, they can be perceived in different ways. Many participants mentioned that organics was historically perceived as a set of practices only employed by farmers who were bad managers

of their land and business. To a certain extent, this belief lingered among some of the conventional participants as well.

> *Husband: "…only the poor farmers went organic. And that probably has typically been true I think in this country…You'd go to organic farms and they just looked awful. They were run down, stock were terrible. It was like organic was an excuse for being a really bad farmer. But now it's not like that. You've got some pretty astute people who are farming organically as serious businesses." (K, organic farmers, Otago)*

Nowadays, there are premiums available for supplying organic milk but not in every location and not from every dairy company. It was common for conventional participants to claim that the organic premium would disappear over time if too many farmers were to supply this niche market, and that there, therefore, was no benefit to converting. For biological production, there are no premiums available, which seems to make conventional farmers doubtful as to the relative advantage of adopting such a system.

> *"In terms of markets and premiums and extracting premiums from consumers, yeah, it's a great marketing story. It works. People are doing quite well out if it, but I don't know how long that would last for, you know…We don't get paid any more from our milk company for feeling good about biologically producing our milk. That's just something that you do for yourself, isn't it?" (N2, conventional farmer, Southland)*

> *"And then, if everyone just starts doing it biological, a lot of people are just going to try and get the premium saying 'mine's a premium product, so I should get more than him over there for my milk because mine is special'." (I2, conventional farmer, North Island)*

Conventional participants appeared to focus more on the potential premium offered to produce value-added products. Biological and uncertified organic practitioners do not receive a premium from their milk company indicating that these farmers did not convert their systems due to an external monetary incentive. Rather, these agroecological participants perceived that other benefits were enough to adopt that type of system. Even some certified organic producers have commented that the premium was not their main reason for changing system. Some current biological participants, however, see the premium as an incentive to convert to organics. In these cases, the external monetary incentive might present a sufficient reason to become certified.

> *"If we could find someone to take all our milk supply, we would convert to organics. And it's not because I'm a total believer in organic principals, it's the premium, value-add side of it." (O, biological farmer, Canterbury)*

Wife: "Organic dairying down here, they're not getting paid the premium to make it worthwhile." (N, biological farmers, Southland)

Despite no dairy company offering a premium for biologically or uncertified organically produced milk, the beliefs around the expected outcome (response efficacy) of selling directly to consumers could influence some to market independently of dairy companies. By having a more direct relationship with consumers, farmers are able to tell their story and explain to their consumers the benefits they see their production system having, thereby creating a possibility to collect a premium for their product. One organic participant only became certified when the family decided to process their own products into cheese, simply because they saw it as a marketing advantage.

Some conventional participants also mentioned their belief that organic production will not be able to feed the world and was, therefore, not a system they would like to pursue. Other comments centred around being unable to spray weeds and use antibiotics to treat animals under an organic system.

Wife: "The thing is, if we all go organic, we can't feed people. It's as simple as that."

Husband: "Organic milk is hard work. It costs a lot more to produce the milk because…if you get mastitis or a lame cow, you can't use any of the drugs that we use to treat that. You have to do it with honey and praying I guess…And it's also the little things, you can't spray weeds." (M2, conventional farmers, Southland)

The image of organic farming in the dairy community appears to be quite varied, where some see it as a viable business opportunity and others see it as a sign of bad management. In terms of marketing opportunities, however, conventional farmers agree that the image that organic farming has is a positive one and that this may influence farmer decision-making.

Wife: "We can probably sell our product for more because we can go back to that greener image. You know, I know there are certain products that we get more money for overseas because it's got a New Zealand sticker on it. And perhaps there will be more people moving to the organic side of this to combat it…I'm not that keen on going organic myself but farmers of the future..." (M2, conventional farmers, Southland)

"I suppose I am looking at the organic side as probably a lot more sustainable and…it is a growing market. At the moment, a lot of New Zealand milk is going into milk powder which anyone can do. If we can become more niche maybe, then there should be more opportunity for upside I guess in time." (H, biological farmer, North Island)

It is clear that there is some stigma attached to both biological and organic production systems among conventional participants. There are, however, also those conventional participants who see a lot of overlap between systems, and how conventional practitioners can learn practices from organic or biological practitioners.

> *"It'll takes us too long to change [to organics] now anyway. But, we've talked about 'perhaps there's better ways putting on nitrogen. Rather than just using urea'…There are options out there." (O2, conventional farmer, Canterbury)*

> *"…there's more and more focus on using less antibiotics. Dry cow therapy and so forth. Well, organics has been doing that for a number of years so there must be some expertise there that the industry as a whole can use." (L2, conventional farmer, Southland)*

The beliefs around what exactly different practices and production systems entail can clearly influence an individual's attitude toward them. These attitudes may then act as enablers or barriers to whether they even consider such practices, let alone feel confident enough to adopt them. Beliefs about the profitability of the industry in the future, changing consumer trends and the emergence of new markets, as well as changes to industry standards, have a clear impact on the threat appraisal that participants make in relation to their farm system. In many cases, those who have converted recently have used the precaution strategy (described in Section 3.1) and changed their system in response to a threat that they see coming and that they felt able to respond to. Changes have included reducing the use of antibiotics or PKE, as well as more substantial changes, such as converting to organics.

5.3.9 Norms

Norms (social, personal, and subjective) that are present in society were found through literature review to have a large influence on farmer decision-making and was placed as an influential factor acting on threat and coping appraisal in the conceptual framework. It can be challenging going against the social norm and could present a barrier to adopting new practices. As described in Chapter 2, the vast majority of farmers farm conventionally, which could make a move towards agroecological production systems daunting. If seemingly everyone else is dairy farming in a particular way, it can be difficult to make a change and follow a different path.

> *"Coming from conventional, you're sort of always supposed to be putting something on or spraying something." (G, organic farmer, North Island)*

> *"I never really liked putting on nitrogen and stuff…It was just because…all these new farms were being developed out on the plains and nitrogen was getting poured on everywhere. So I*

thought that 'shit, that must be the way you do it now'. So I tried it and you obviously get great results with nitrogen but found that the costs and extra work and the extra production I got out of it wasn't worth it." (E, biological farmer, Canterbury)

Individuals' response to what social norms dictate, what the social group they belong to sees as normal, or the new trend, is an important driver for behaviour. If a certain behaviour or management practice is perceived as common in society or their farming group, farmers are more likely to act in a similar way. It was a challenge for some recently converted agroecological participants to change production system from the conventional because the changes they were contemplating fell outside the social norm of how farmers usually operate their systems. The prospect of not following the social norm created a worry that they were doing something wrong or were seen as "bad farmers" by their peers.

Husband: "Initially we were using quite some bad advice, and we kind of got on the bandwagon. Like, everyone was CIDRing and PGing[13] and all the different things that more conventional farmers [do]. You know, if you do that, you're a good farmer. If you don't, you're not a good farmer type thing." (K, organic farmers, Otago)

"Our system before was pretty much a standard up here and everywhere. Urea and all that sort of stuff. I was never a great fan of it but there was almost seen as a necessity. There didn't seem to be any other options or anyone out there promoting any other options. I really felt like, if you weren't putting on this, that and the other thing,…you felt like you were doing something wrong pretty much." (G, organic farmer, North Island)

Some participants who had converted recently from a conventional production system stated plainly that it was difficult to change their own mindset when habits learned from other farmers or educational institutions or sales representatives are the norm in society.

"I guess in my generation, we've come along and just been told that 'this is what you do - you spray out a paddock…and then you re-grass it', or whatever. We have never been told that there is an alternative too, and we probably haven't gone looking for it because that's what, you know, we were taught to do. So we don't even question the reps." (H, biological farmer, North Island)

Trusting the management practices of the majority, friends, and family as being "the best way to farm" seems to be an underlying mechanism for initially choosing a production system. It is clear

[13] The practice of synchronising cows' heat and bringing on heat by administering hormones (K, organic farmers, Otago).

from the interviews that changing practices created some challenges in terms of going against what the participants thought was expected of them as farmers. Being taught from an early age "how to do it" and seeing it practiced by your peers, makes it easy to follow suit. Social connectedness and observational learning, which were discussed in Sections 5.3.2. and 5.3.3., are among the factors that thus show clear interactions with social norms.

Interestingly, a difference could be observed between actual and subjective norms. Some agroecological participants indicated that they worried about the thoughts of other farmers prior to converting their systems. For those participants, their belief and confidence in their new chosen system was strong enough to allow them to ignore the social norms and make the change regardless. Contrary to expectations, however, some participants were pleasantly surprised by the reactions of their conventional counterparts.

> *"I was expecting a lot of people giving me a bit of stick about it, going organic; but it is amazing how many people want to know what we're doing and how we're doing it and everything like that…They look over the fence, and they've said to me 'Well, what are you putting on your place because it looks better than my place?'." (G, organic farmer, North Island)*

In this way, subjective norms may act as a barrier to changing behaviour if the farmer hesitates to redesign their system due to perceived social norms. Actual social norms could, by contrast, act as a barrier in cases where the intention to behave has formed and your peers or other important people in society react in a negative way that make you reconsider your plans. In the quote above, however, the farmer received a positive reaction, which instead reinforced his decision to go organic.

Norms are important to include in a model on decision-making, but it is not conclusively clear from the interview material where to place them. Based on the indications in this section, norms should perhaps be divided into subjective norms and actual social norms. Subjective norms would then act as influential factors acting on threat and coping appraisal, and actual social norms as a form of facilitating condition moderating behaviour. Personal norms were not noticeably evident from the interview material, other than being related to biospheric values (see Section 5.3.7).

5.3.10 Facilitating conditions

Sections 5.3.1-5.3.9 have discussed the influential factors, which, in the conceptual framework, acted on threat and coping appraisal. The next two sections will discuss factors that moderate

behaviour once the motivation to change (or stay the same) has been created and an intention has formed. Facilitating conditions is one of these.

Facilitating conditions can include a multitude of circumstances that enable or constrain the intention to become behaviour. Participants were prompted to explain whether there was anything that made it possible for them (or hindered them from) taking a leap when changing practices or production system. Location and financial capacity were two important conditions that were identified from literature review, as well as mentioned specifically in the interviews.

Location

Location was the factor most often mentioned to have an impact on the management of the farm, particularly in relation to climate, proximity to services, and land prices. The ability to manage the business living in a dry or a wet area and how those conditions change over the course of the year were often topics of conversation where experience directed which management practices were employed. In some regions, the soil type was a determining factor in land use regulations to control nutrient leaching. In a few cases, the attributes of a certain location were important to the decision of setting up a dairy farm in that area.

> *"We targeted somewhere with a good reliable rainfall and a farm that didn't require a whole lot of staff to operate. So, we ended up with this place." (N2, conventional farmer, Southland)*

> *"We were pointed in the direction of [place name] by our bank manager…Its proximity to Christchurch makes it easy to get staff. The land, the altitude, the reliable irrigation. Near a milk factory. We're near a number of dairy companies that we could supply. We've got all the services around us." (D2, conventional farmer, Canterbury)*

> *"This was back in 2009 when Canterbury was the land of opportunity. If you wanted to make a name for yourself, you came down here. So I came down here." (F2, conventional farmer, Canterbury)*

> *"Originally we came down here because of the price of land and the opportunity to get into farming down here." (M, organic farmer, Southland)*

The proximity to different dairy companies could also be an important factor when deciding which value-added products to supply.

> *Wife: "I mean, it's all very well to think it would be nice to be an organic farmer, but you need someone to pick up the milk and sell it. I think that was quite a big key as well." (K, organic farmers, Otago)*

In some cases, the dairy company could be interested in the product farmers are able to supply but do not find it economically viable unless a number of farmers in the area supply the same product.

> *"I'd like to supply the milk company with A2 milk but…until someone else decides to go A2, they won't send the tanker around just to pick us up." (E, biological farmer, Canterbury)*

The proximity of dairy companies and which value-add options they offer their suppliers (e.g. organic, A2 or grass-fed only milk) could influence a farmers' decision to produce those products. This is, however, not an option for those farmers who are uncertified organic or biological, and so the proximity of dairy companies would have a limited influence on their decision to adopt those production systems. Likewise, organic participants A, M, and J converted to organics even though there was no dairy company in their vicinity who offered a premium for supplying organic milk. As described in Section 5.3.7, they were largely driven by values. One of the organic participants who had converted more recently was also not influenced by the location of a dairy company in order to supply organic milk.

> *"We were with Fonterra, but we weren't getting their incentive payment or anything like that to do what we were doing." (G, organic farmer, North Island)*

Instead of being incentivised by a premium, this participant indicated a different set of reasons for his and his family's choice of system, which was mainly based around survivability and resilience in a changing market. The premium, although appreciated, was of secondary importance, but appears to be an incentive to stay with a certain dairy company for another participant.

> *"Fonterra doesn't pay an organic premium in Southland, whereas Open Country do. So that's the reason for staying with Open Country now." (M, organic farmer, Southland)*

Proximity to processors and options that dairy companies offer can have an impact on the alternatives available to farmers in their area. If available in their area, supplying products that receive a premium price from the processor is one avenue that farmers can take to improve the bottom line.

Financial capacity

Certain conditions may make it difficult to change practices or production system even if the will to do so exists. The need to be profitable and pay off debts owed to the bank or shares in Fonterra can be a significant barrier to develop the farm in the direction in which a farmer would ideally like to go.

Husband: "I've sort of often wondered if we dropped [the runoff block], if we could just pull back on [cow] numbers a little bit...but debt still makes us milk more cows here [laughter]. That's the main driver at the moment." (N, biological farmers, Southland)

"The farm is bought with 100% borrowed money…It's supposed to be paying interest on the entire value of the farm…it's quite a challenging spot financially that we still do have to make profitability decisions that is not all about environmental practices and animal welfare…we got to remain profitable. Otherwise, we'll get kicked off." (F2, conventional farmer, Canterbury)

For these two farmers, financial constraints were the main barrier for them trying to reduce the intensity of their operations. Another barrier to behaviour can also be how cheap an alternative product is in relation to the one you want to use. An example of this is the use of palm kernel as feed, as described in an earlier section. Seeing that dairy farmers in New Zealand are heavily indebted (Galloway, 2017), it is likely to be a common story. When asked whether he had considered trying biological fertilisers, conventional participant F2 replied that he perhaps would in the future, but that he is not in a financial position to take that risk because it takes a number of years to see results from the application of it. Even when not constrained by high debt, a farmer who would like to spend more time and effort on other aspects of the farming system, such as reducing environmental impact or enhancing animal welfare, may face other factors specific to their farming context that influence their decision-making and limit their ability to achieve their goals.

Removing barriers could act as facilitating conditions to adopt something new. Debt levels and lack of relevant information are already mentioned as examples of barriers that may restrict trying new practices. Their business structure could be another.

"I'd love to try new things [organic and biological fertilisers], but it is really hard to because of the corporate farming. You cannot trial and then say 'Ah, that didn't work' because you've got to perform for the group. You've got to perform." (B2, conventional farmer, Canterbury)

"It would have to be a family decision [to go organic]. I'm not sure." (G2, conventional farmer, North Island)

Facilitating conditions, regardless of what form they take, seem to be of clear importance to make intentions translate into behaviour.

5.3.11 Habits

Although habits had been placed as a moderating variable of intention translating into behaviour in the conceptual framework, the data collected in this study does not support its placement there.

The interview material that was coded for habits more appropriately belonged in Section 5.3.4 on prior experience where participants explained how their current practices are influenced by those the family used in the past. It never became apparent that participants had the intention of doing something new but were hindered by old habits. This could be a result of two things: either the questions in the interview schedule did not adequately allow for habits to be highlighted; or habits are more likely to be an important factor in low-cost behaviours, such as going by bike to work rather than taking the car. The implications of habits in this type of situation would be fairly small (i.e., it will not harm anyone or anything directly). A larger-scale decision, such as changing practices or production system, is likely to have been more carefully considered and the relative advantage of changing would be very clear to the individual, and hence the influence of habits might be indiscernible.

5.3.12 Threat and coping appraisal

The factors acting on threat and coping appraisal, and those that moderate behaviour after an intention has formed were outlined in the previous sections. This section will discuss threat and coping appraisal as cognitive mediating processes between those two sets of factors. As outlined in the conceptual framework in Figure 11, threat and coping appraisal are evaluations of maladaptive response (no change) and adaptive response (change). The former consists of perceived rewards minus perceived severity of the event and the vulnerability of the farm business to it. The latter consists of the expected outcome of an alternative approach (response efficacy), self-efficacy, and perceived behavioural control, minus perceived costs. It can be difficult to separate an evaluation into rewards or costs as these are inherent to the other factors that together compose threat and coping appraisal respectively. For this reason, the overall evaluations are mainly discussed in this section.

This section takes a specific look at threat and coping appraisal in relation to environmental regulation, as it was a common topic in every interview but which affected the participants differently. The amount of nutrients (specifically nitrogen (N) and phosphorus (P)) that farms are allowed to leach currently and in the future is determined by regulations. To meet the limits set within regulations, regional councils require farmers to use tools like the software OVERSEER to create farm environmental plans to which each farmer must adhere. The general idea is to reduce the amount of leaching over time, primarily to improve water quality. The regulation of nutrients varies from region to region. In addition, variation in units allocated within regions depends on factors such as soil type and current leaching rates. This means that a farm might be required to reduce their leaching by a lesser amount than that of their neighbour, which may lead farmers to perceive different levels of stress associated with the threat and initiate different adaptation

measures. Due to the imposed limitations, some participants realised they need to change their application of fertiliser, whereas others did not.

> *"We had to do a farm environmental plan…I understand that we keep our baseline figures which is 108 kilos...Well, on that farm in [place name], we can have a reduction of 50% and we are still alright because we've got that good baseline figure…So I think we are in a very good position." (D2, conventional farmer, Canterbury)*

> *"We just got to stay under 40. And under 40 we can run 3 cows to the hectare…We've got enough flexibility…So we can just carry on doing the same thing we do on both these farms with our consents and not really have an issue." (H2, conventional farmer, North Island)*

These participants do not seem to feel much pressure from reduced nutrient limits. The new limits are not perceived to be severe enough to pose any major threat to their current fertiliser practices, which enables them to continue business as usual. Other participants, however, see that they need to adapt their system in the future to cope with the nutrient leaching consents. The threat is currently not perceived to be severe enough to warrant any immediate changes.

> *"We sort of push N to the limit, so we're putting on 260-280 units of N. But with the way things are, we can't do that for much longer [due to incoming regulations]." (B2, conventional farmer, Canterbury)*

Most participants felt some form of worry about what the effects of these incoming regulations would be and how farmers in general would cope and what adaptations would eventuate.

> *"What it will do to us in New Zealand, is that it will force us indoors. It's going to force us off the paddocks. This system I run now, the pastoral free-range system, will become at risk unless we want to have really light stocking rates." (J2, conventional farmer, North Island)*

> *"I know a lot of people are moving towards the barns and feed pads sort of thing, that's purely to try to get the nitrogen leaching down on their properties, I guess." (E, biological farmer, Canterbury)*

Apart from the prospect of housing cows indoors, other adaptations to regulation included becoming self-contained, improving the genetics of the cows, and changing wintercropping, which illustrates the range of responses participants are considering and how efficient they are perceived to be in countering the threat.

> *"When I first converted, there were no environmental issues at all. You just got as much water as you could and put as much nitrogen on as you could to grow as much grass as you could,*

and that was good dairy farming back then. Obviously, things have shifted since then; so I kept trying to direct the farm system to hopefully best suit where I sort of saw dairy farming going from a reglementary space. Initially, we weren't self-contained. We now are." (F2, conventional farmer, Canterbury)

"Now with ECan [Environment Canterbury] coming with nutrient leaching and that, we may have to downsize our cows to make that work, which is not a bad thing, because one cow can be producing 2.5 milksolids and another one produce 1.5. You've got to work on genetics to get all your cows in the herd milking 2.5, which will help that downfall." (C2, conventional farmer, Canterbury)

"We've kicked out all our wintercropping in there because one thing that was glaringly obvious to us while we were looking for N loss mitigations in our system was the winter-cropping. It was dropping a shitload of N out of it, so we just got rid of it." (J2, conventional farmer, North Island)

The first quote is an example of lowering inputs. The second quote is an example of intensification or maintaining the same intensity of the current system (i.e. more productive animals are bred to increase milksolids production because regulations restrict an increase in the number of cows). The third is an example of eliminating an intensive practice. Whether the farmer chooses to intensify or de-intensify depends on the options available on their farm and the perceived benefits of the change (Table 6), their financial and personal goals, as well as on how severe of an impact they perceive new regulations might have on their business and how vulnerable they are. It also depends on whether the farmer feels that they have the capability and confidence to make the transition (behavioural control and self-efficacy). to Some of the agroecological participants mentioned that they think that many farmers will move closer to their type of production systems due to the regulations being in place. For some, this may also be an incentive to convert from biological to organic production.

"I sort of think that in the next 10 to 15 years, I think we could nearly be made to farm 90% organic or something anyway. Like a lot of farms might be there just about, just because of the environmental restrictions that will get put in place." (H, biological farmer, North Island)

"I wouldn't say any of our neighbours would convert, but we have farmers ring us, and we had four farmers from the North Island come down two weeks ago, to look around farms that were using biological products. So, I would say we are seeing more farmers becoming aware

of it than there were five years ago. But I think it's because it is being forced upon them to look at other alternatives." (O, biological farmer, Canterbury)

Beliefs, as part of influential factors acting on threat and coping appraisal in the conceptual framework, have a clear impact on participants' decision-making. These affect the perception of the severity of anticipated incoming regulations and how vulnerable the farm business is to that happening. Adaptations range from tweaking the current system to full redesigns of the production system, which is likely to stem from beliefs on how effective the response will be and how well they can implement the changes. All these evaluations are highly individual and depend on context and intrapersonal factors as well as social connectedness. For some farmers, however, the stress associated with external pressure (vulnerability and severity of threat) and the impact on personal wellbeing may become too much which might lead to an exit from the industry altogether. For them, the evaluation that exiting the business is the best option to the perceived threat is the result of looking at the different options available and what the perceived benefits are (response efficacy), and what they feel that they can confidently achieve (self-efficacy and perceived behavioural control).

"In the Waikato, there's a number of aging farmers up there that have found the same thing, that all the stuff is just too much. 'I've got money in my farm, why am I working my ass off and not really enjoying things? It's better to just sell up and enjoy life and get rid of all the stress and move on' which is probably similar sort of thing to what I'm at, at the moment." (F2, conventional farmer, Canterbury)

"A lot of [young sharemilkers] were saying '…As a sharemilker, I make a 20 per cent return. If I buy the land, I'm making two per cent'. The thing is that, previously your land value always went up seven per cent each year. That's where you got your capital gains. Even though you were only getting two per cent perhaps return, you're getting a gain on gain in the land value, but with all the rules and regulations and environmental things, that could change. Value could actually go down. Because you can't just buy a farm now and ramp that up and put more cows on…anymore. Because the rules are gonna change. That's changed their perception." (O2, conventional farmer, Canterbury)

The last participant explained that some sharemilkers had decided to buy commercial property rather than aim for farm ownership. These younger farmers see a relative advantage in pursuing careers in industries outside dairy farming that are less stressful and more profitable. Similarly, the older farmers in the first quote felt their situation was too stressful and no longer enjoyable. Coping with the impacts of such feelings can be extremely difficult, especially since dairy farmers tend to

love their job with a passion as explained in Section 5.3.6 on affect. Losing that passion, due to increasing pressure and stress, can be a reason to exit the industry as a coping mechanism.

The uncertainty that comes with not knowing which regulations will come into place in the future makes planning and investments very difficult for farmers. This may also have an impact on the adoption of new practices and how farmers decide to use their land.

> *"I think as more people come to understand what these new rules will mean, that we'll see further reductions [in land values]. I don't think farmers have any idea of what's coming…Most farmers have no idea. No idea…Once there is sort of more mass understanding, the message gets out that this is pretty serious, that we'll start to see land use change." (F2, conventional farmer, Canterbury)*

> *"I guess the drivers will be more economic. That might be in response to ECan [Environment Canterbury] slapping on tougher nutrient limits so people will have to look at other ways to manage their production, so they can have biological ways as well instead of putting on NPK. So, I think it would be those kinds of drivers rather than a cultural shift in the hearts of our farmers." (C, organic farmer, Canterbury)*

Regulations have a direct effect on farmers' businesses as they may feel forced to adapt or change practices in order to be within the set nutrient limits or adhere to other forms of regulation. Some farmers seem to anticipate that regulations are going to get worse, and this belief has made them think of ways in which to respond. There is a sentiment among those who have considered or have already implemented greater changes on their own farms that environmental regulation will become more severe, and that there will be changes in land use when other farmers realise the scope of it. For some, adaptations and substitutions of practices or products have been deemed sufficient, whereas others have taken it a step further to redesign their entire system. The difference is likely to lie in the perception of the severity of the threat and how vulnerable the business is to further regulation. The links to threat and coping appraisal outlined in the conceptual framework are evident.

Although this section has mainly outlined regulation as an example of how participants experience and appraise different levels of stress and perception of threat, the experience extends to a number of other issues as well. Examples of issues covered in the interviews include changing consumer trends, family farms disappearing, climate change, staff retention, succession, biosecurity risks, corporate takeover of farms, lack of independent advice, increase in land prices, milk price fluctuations and geopolitical tensions.

5.3.13 Autonomy

Aside from the factors that were presented in the conceptual framework, additional factors emerged from the interviews that were not originally considered in the conceptual framework. Autonomy is one of them and was mentioned often by participants, who preferred the ability to choose practices or production systems that enabled them to retain autonomy. Autonomy is an essential element of job satisfaction and subjective wellbeing among self-employed people (Benz & Frey, 2008), and is a core value among farmers that often equates to being one's own boss and having a lifestyle connected to farming (Stock & Forney, 2014). Farmers have the choice to decide among a multitude of different aspects of their management, such as which production system to operate, how much they rely on imported feed or fertiliser, and how much debt they are willing to accrue. The freedom to choose the activities of each day, the diversity of activities inherent to being a farmer, and being one's own boss were regularly mentioned as some of the best things about being a dairy farmer.

> *"But it's fun! It's really diverse, right? [laughter]… There is a really broad range of intellectual and practical knowledge that I need, like plumbing and accounting. Being able to understand regulations, being able to apply them, being able to challenge regulators when you think they've got it wrong, lobbying the government and…all those kinds of things so. Yeah, farming is diverse." (C, organic farmer, Canterbury)*

> *"Being your own boss. I mean, my wife gets sick of me having to be here. You know, the tie of the farm, especially being small and not having any full-time workers. For us to go away, we've got to organise someone to come in and take over. That's the only downside of it. No, I just love it." (E, biological farmer, Canterbury)*

> *"It's funny, there are so many jobs you do when you're dairy farming and they're crap jobs and you think "Why the hell am I doing this?", because it's not pleasant jobs, but yet I still think it's a great life. I guess, for me now that I've got into farm ownership, that it's the autonomy that I have. It's the fact that I'm self-employed and I'm in charge of my own destiny with this business. I get to live in this beautiful spot, and no one tells me what to do every day. There's a whole range of job satisfaction-type measures you could talk about. Yeah, I just get to do what I love. I really enjoy being self-employed." (N2, conventional farmer, Southland)*

Many participants mentioned that there is no wrong system of dairy farming, as long as it suits the farmer's goals and unique circumstances. There are many different systems and practices that farmers can choose (e.g. high-input, grass-based, organic), and the participants cherish that autonomy to choose their system and the feeling of wellbeing that comes with it.

"I like variation and challenge. You're free to go any direction you want. We've gone the biological way, but that's not the right way for everyone. For some businesses, this is the track you follow, and that's where you go. We work hard, but….we've got to the position where we're happy." (O, biological farmer, Canterbury)

"There are options out there…I don't think there's any 'You have to do it this way and that's the only way you do it'. Everybody farms differently. And who's to say that just because they farm that way that it's the wrong way or the right way. I think there isn't any wrong or right way; it's what you want to do." (O2, conventional farmer, Canterbury)

"Being a dairy farmer is amazing. You get to get up, do what you want, pick that system…there are so many choices. You could be an organic farmer if you want. You can change from one to the other in a matter of years. It's so diverse." (J2, conventional farmer, North Island)

Many participants mentioned losing motivation as a result of loss of autonomy. Some even mentioned that people they knew had quit dairy farming because of feeling down about it. This feeling was grounded in the sense that decision-makers are not in touch with the farming profession and are not being practical as regards new regulations making it unnecessarily difficult to farm. Many felt that farmers should be given more opportunity to shape the regulations to achieve better outcomes for everyone.

"I just don't want to see regulations getting any worse… And we've lost a lot of good farmers because of it, because they just can't be bothered with it. And you lose your motivation. And I think they've [regulators] got to be very careful they don't go too far because it's going to hold things back. Don't get me wrong. A lot of those things need to be there, but they've just got to be very careful to make sure you are going to get a benefit out of it. And a lot of these people enforcing the rules and regulations haven't been involved in the industry, and they're ticking boxes and not being practical." (D, biological farmer, Canterbury)

The frustration with government regulation extended to biosecurity concerns as well.

"So, M[ycoplasma] bovis is out there… My feeling is, MPI, media and government is all making…a common cold being made to sound like an Ebola epidemic. A lot of countries deal with it. Sure, if we can eradicate it, that's great. But one of the comments I heard was that MPI should've given it to the farmers to sort out and the farmers would have sorted it out." (B2, conventional farmer, Canterbury)

Autonomy seemed to be equally valued by all participants across the spectrum. Participants were conscious of acting in ways to take care of the environment in ways that suited their farm best. This

is an example of autonomous motivation where farmers, through measures that they choose themselves, act in pro-environmental ways in which to safeguard the land for themselves and future generations without being forced to through regulation. Autonomy could become restricted and subsequently create so called controlled motivation where farmers are not voluntarily complying with regulation, but do so because they fear punishment if they do not (Deci & Ryan, 2008b). The frustration with regulation among participants appear more centred around feeling that farmers are not consulted in the formation of them, or that their concerns are not adequately taken into account, rather than the actual content. This is important to consider in terms of policy consequences on relationships between farmers and authorities. It would be advantageous for authorities to encourage autonomous motivation where farmers have acted pro-environmentally because they perceived a relative advantage of changing practices without being forced to by external pressure.

5.3.14 Significant events

Significant events also emerged from the interview material as a factor that appears to have a special influence on the creation of a threat appraisal for some participants. For some participants, significant events have initiated the decision-making process of looking into alternative production systems. A significant event may be an acute dramatic event, such as drought or sudden illness, but can also be a sudden unexpected opportunity. A significant event could also be a chronic situation that builds up over time until it becomes untenable, such as mental health. In either case, such events provide a chance for participants to step back and look at the whole system, without which change may not have occurred. In this way, the significant event acts as a trigger for the decision-making process to start.

> *"Through that process [buying equity partner out and taking over farm ownership], it's made me look a lot harder [at] how the business is set up presently and how I want to set it up going forward. And that's where I guess I started looking around at more low-cost systems…at the organic side or biological farming…And I guess, if I hadn't had the chance of the change of ownership or something been different, then I wouldn't have given it much thought. I would've just kept going the way that we were going probably. More than likely." (H, biological farmer, North Island)*

> *"Four years ago, we picked up some leased land next door on long-term lease. So we had to make a decision whether we were going to increase cow numbers and continue what we were doing, which seemed to be getting more and more inputs and almost chasing our tail a lot of the time…It was mainly due to the change in circumstance that made us look into 'Where do*

we actually want to be down the track?' and it wasn't…in this conventional system that we were in really." (G, organic farmer, North Island)

In the second case, leasing additional land is claimed to have been the significant event that made this farmer and his partner stop and think about their long-term goals and aspirations, and reconsider their whole farming system in that context. In the interview, the participant explained that he and his partner found that intensifying their current system was not compatible with their values, such as spending time with their children and de-stressing. In both cases above, the farmers converted from conventional systems within the last five years, and also considered recent societal shifts in consumer demands and public perception as reasons to change.

Three participants had been agroecological for more than ten years and made their decisions under different societal conditions and in response to different threats. The significant events which influenced them were related to human and animal health, as well as a fortuitous visit by a biological products salesman.

"I sprayed the ground just with…I think it was [chemical brand name]. A terrible thing and I felt ill after it, and I thought 'Well, I'm never doing this again. That's it'. … It was really that thing I think that made me do it [convert to organics]." (J, organic farmer, North Island)

"…we've now gone on to be organic farmers. That goes back to our family history of cancer. So we decided to take chemicals out of our farming system." (M, organic farmer, Southland)

"…we had huge issues converting to seasonal supply with reproduction, getting them in calf, a lot of lameness, a lot of mastitis and these issues. So, we just started looking at other alternatives, to try and deal with them... That was probably the biggest reason for looking at it [biological]…[and] we were lucky enough to have someone coming off the road, willing to do full trials on a biological product against the product we were using at the time. …so, it was possibly a bit of luck that they came along." (O, biological farmer, Canterbury)

These accounts suggest that a significant event may function as a trigger for the decision to adopt different practices or production system. Mastitis and lameness of cows are two major animal health issues that farmers deal with on farm that have implications on reproduction rates, input costs, and, by extension, profitability. Participants mentioned phasing out the feeding of palm kernel extract to cows, reducing the use of synthetic nitrogen fertiliser, and adopting a once-a-day milking system as options that would help improve animal health. Poor animal health could thus also be categorised as a significant event due to the built-up stress that this has created over time.

"There were probably five things that turned me to go once-a-day…we had a lameness problem sometimes coming out of winter because winter milk[ing] was hard on the races. And I thought if I could halve my traffic on the race, then halve my lameness, and I think we've more than halved it. We haven't even got a problem anymore. We had bad mating results…So that was another reason for changing. Labour, lameness, poor mating results, small cowshed." (I2, conventional farmer, North Island)

"We don't use a lot of urea compared to a lot of people…I know that stock health without nitrogen is a lot easier…When you are using a lot of nitrogen, you do run into more problems." (E2, conventional farmer, Canterbury)

Participant B, who is operating a biological production system in Canterbury, similarly explained that they had massive issues with soil compaction, thatch and spring eczema of cows. Other stock health issues, such as mastitis and laminitis, were also severe problems affecting production as well as profitability. He said that these events were stressful and caused him to look for reasons behind the problems they were facing, which led him to find and evaluate other systems.

Hence, the same problem can have multiple solutions and, indeed, a single solution can have multiple benefits. For some, a transition to an agroecological system was the answer to their animal health problems, whereas for others, reducing fertiliser use or switching to a once-a-day milking frequency was the answer. The perceived severity of the threat appears to influence the decision to adapt or redesign the current system. Certainly, a great number of agroecological participants mentioned animal health issues as a reason for why they had been looking for alternatives to their original conventional production system. This could indicate either that they had more animal health problems on their farms to start with or that they felt more stressed about it. Either way, if the problem was considered severe, it may be regarded as a significant event that acted as a trigger to change the production system in order to reduce the feeling of stress.

The drop in milk payout in the seasons 2014/15 and 2015/16 was also referred to as a significant event that had an impact on farmer decision-making. This had a dramatic effect on farmers all over the country, with some having to borrow large sums of money to make ends meet. Despite the negative effects, this type of event may also create a moment of reflection on the intensity of the industry as a whole as this farmer does:

Wife: "A drop in the payout every now and then is quite good because it reminds us [dairy farmers in general]. It educates us back to farming at low pace." (M2, conventional farmer, Southland)

Significant events may thus act as triggers that sets the current practices into context. This may elicit an evaluation of the whole system (threat appraisal) that has the potential to lead to changes if there is a relative advantage to do so and the changes can be implemented (coping appraisal).

5.4 Construction of web questionnaire

Based on the findings of the qualitative phase, the quantitative phase in the form of a web questionnaire was constructed. The challenges that dairy farmers and participants in this study are facing elicit a certain level of stress depending on the individual farmer's context, circumstances, and intrapersonal and interpersonal factors. The interviews have shown that the prospect of certain challenges, such as increasing environmental regulation, changing consumer trends and industry standards elicit different responses; some improve the efficiencies of their current system, some substitute practices with something that is more suitable, and some opt for a redesign of their production system. Some are also considering an exit from the dairy industry altogether. We have seen that beliefs influence which options are considered as realistic substitutes. For example, some participants would never consider an agroecological system as an option because they do not believe it is viable in comparison to a conventional system. Beliefs thus have a strong influence on perceived relative advantage (response efficacy).

The overview in Table 6 shows the diversity of practices and production systems that participants in this study have adopted or were considering to adopt. Some wish to lower the intensity of, or inputs to, their operation through moving to once-a-day milking or becoming self-contained. Others have changed dairy processor or become independent to be able to produce a value-added milk product. Others have opted for diversifying their income streams, whereas some strive to maintain their current systems as these are the most suitable to their farm and circumstances. This addresses the first objective of this study (to identify which practices or production systems dairy farmers choose to adopt or have adopted). The web questionnaire was, therefore, designed to allow respondents to describe their current and ideal future farming system in relation to these, and other, options in order to later explain their reasons behind them.

The identification of a relative advantage (superiority relative to the idea or practice that was in place before it) is the main cause for change or adoption of new behaviour among the participants, similar to findings by Pannell et al. (2006) and Small et al. (2015). The perception of stress and the perception of a relative advantage seem to be central higher-level concepts involved in threat and coping appraisal, which addresses the second objective of this study (to identify the reasons for the choice of practices or production systems that dairy farmers have chosen or wish to adopt). In order to explore these factors in more detail, the web questionnaire was designed to include a section on

perceptions to gauge how worried or concerned the respondents were on a number of issues, and a section on the perceived relative advantage of their ideal future farming system. A similar section was also included on the reasons behind their choice of current system in order to compare the reasons behind their current choice with those of their future choice.

The content of the two sections on reasons behind current and future farming system was influenced by the testimonies of the participants and include a range of potential reasons, which reflect the factors identified as being important to their decision-making. Each reason could be rated on a five-point Likert-type response format from 'Not relevant/Does not describe my system' to 'Extremely relevant/Clearly describes my system'. The offered reasons for choice of system and the factor they relate to are listed in Table 7. The majority of reasons that could be ranked for both current and future farming system are related to beliefs with the acknowledgement that these interact with other influential factors such as values, attitudes, norms, and personal characteristics.

Reason	**Factor**
* I know this system well from growing up	Prior experience
* Was advised that this system is the best	Social connectedness
* Had to trial and read a lot before I chose this system	External knowledge
* Saw other farmers adopt this system with success before I chose it	Observational learning
* I feel good using this system	Affect
Ease of management The system gives me enough time for family and friends Low cost High profitability The system capitalises on available premiums/value-add Good market access High production levels The system is flexible and allows me to change things rapidly if need be Low environmental impact Good animal health The consumer wants this system The use of this system can improve public perception Resilient to • Seasonal weather constraints such as droughts and floods • Fluctuations in interest rates • Milk price volatility • Fluctuating input prices such as fertiliser and feed • Biosecurity risks • Any incoming regulations	Beliefs

*Table 7. Factors represented in the web questionnaire. * signifies questions that were only asked in relation to respondents' current farming system. All others were offered for both current and future farming system.*

Response efficacy was gauged through questions on the perceived benefits (relative advantage) of, and motivations for, changing practices or production system. There were, however, no questions directly associated with perceived behavioural control, self-efficacy, or response costs. Instead, coping appraisal was tested along with facilitating conditions through the final three open-ended questions, which were designed to understand what support (if any) dairy farmers require to adopt or maintain their choice of practices or production system successfully. Respondents were asked to give suggestions as to how their current or future farming system could be made easier to manage or make possible to reach, and how they would improve the dairy industry if they could choose freely. Respondents could thus explain if there were any particular barriers that, once removed, would allow them or give them the confidence to implement their desired changes.

Threat appraisal was tested extensively through investigating beliefs and attitudes in the section on perceptions of the dairy industry. Respondents were asked to indicate on a five-point, Likert-type response format from 'Not at all' to 'A great deal' to what degree they were concerned (or not) about a vast number of issues with regard to the current state of the dairy industry and its future. The issues listed were taken from the interview material that participants had discussed, and included topics such as family farms disappearing, corporate interests, climate change, potential incoming taxes and regulations, and consumer demands. The full list of issues can be viewed in Table 15 in Chapter 6. These questions gauged the perceived severity of the threats. The interview material indicates that severity of a threat influences the amount of change (or lack thereof) a farmer considers. For example, most conventional participants expressed great faith in the future of conventional dairy products and did not perceive the emerging market for synthetic and alternative milks to be an imminent threat. For this reason, they did not consider any major changes. The vulnerability of the farm business to these threats and the rewards of maintaining the current practice or system were not tested directly.

The web questionnaire was designed to explore the processes that were found to be the most important in the qualitative phase of the study in order to address the third objective (to synthesize theory from the results of the first and second objective to show the main processes of decision-making). Therefore, the major focus was on the perception of stress on the farming system (part of threat appraisal) and perception of relative advantage (part of coping appraisal). Respondents were asked to identify the region in which their farm is located to be able to see if different regional regulations had an effect on the results. Any differences could have potentially been related to stronger feelings of stress due to harsher regulations or restrictions in an area. Similarly, respondents were asked to rank how dependent their farm is on irrigation in order to evaluate whether increased reliance on irrigation would increase the perception of stress on the system.

Among the influential factors in the conceptual framework, prior experience, social connectedness, external knowledge, observational learning, affect, were only included to a minimal amount in the web questionnaire. On the other hand, values, norms, significant events, personal characteristics, and autonomy were not at all included. Although these were not deemed to be central processes, these factors are important in explaining the variation seen in responses and will be further discussed in Chapter 7 when the final model explaining dairy farmer decision-making is presented. Habits were not incorporated into any questions in the questionnaire as they were not shown to be an important factor moderating intention to become behaviour.

The web questionnaire included closed questions on education and background in dairy farming to account for observational learning, prior experience, and external knowledge through education or research being found to have an evident impact on farm decision-making. Building knowledge about different systems and practices, as well as trialling and experiencing for yourself how they work on farm, are essential elements when choosing which system to employ. Self-efficacy and perceived behavioural control really came to the fore when looking at observational learning and prior experience in the interview material. Not only were these important in feeling that the new practice or production system had a relative advantage in comparison to their current system, they were also necessary in building the confidence in order to cope with the change.

It is important to acknowledge that the semi-structured interviews and the web questionnaire provide a snapshot in time with regard to current threats and opportunities and how the participants perceive the world at the time of data collection. For example, two decades ago, farmers may not have considered public perception and, by extension, changing consumer trends to be a threat to their operation, whereas now they clearly do. Comparing respondents' reasons for why they chose their current system is therefore problematic because the decision would have taken place sometime in the past under different perceived challenges and societal pressures. Indeed, a farming system is rarely something that is adopted and set in stone for a long period of time. Rather, it is a constantly evolving process where practices are improved and tweaked to suit changing circumstances and goals. The web questionnaire thus included a closed question on family situation in order to account for some of the variation we might expect to see based on changing priorities as seen in the interviews.

5.5 Summary

The difference between choosing, for example, an agroecological system, a lower input system, or maintaining a conventional system seems to lie in how dairy farmers appraise threats and evaluate different options in order to respond effectively and with confidence. Participants that deem their

farm businesses to be highly resilient to milk price volatility, environmental restrictions, and changing consumer demands, seem less likely to redesign their production system and will strive to maintain or improve their current system. Those who perceive threats to their farming system now or in the future seem more likely to redesign their system or substitute parts of it. There are also indications that significant events have an effect on the influential factors that moderate threat and coping appraisal by acting as a trigger to consider change of practices or production system.

The influential factors outlined in the conceptual framework in Figure 11 were essential factors that the participants considered when appraising threats. Beliefs and attitudes were central to explaining the variation in behaviour and exerted a strong moderating effect on both threat and coping appraisal. Norms could be divided into actual social norms and subjective norms, of which the latter was found to be part of the other influential factors acting on threat and coping appraisal. Actual social norms together with facilitating conditions seemed more to act as enablers and barriers to behaviour rather than a major influence on the main processes, whereas habits were not found to have any influence on the decision-making process. Taken together, it is farmers' perception and evaluation of their own farm system and all its components that determine whether a change in practices or production system will occur. The time and context in which the decision takes place is also of importance and should be reflected in a final model of decision-making. Many participants valued autonomy and favoured the ability to choose practices or production systems that enabled them to retain that sense of freedom. The implications of these findings will be discussed in Chapter 7.

The quantitative phase of the study is built upon the results of the qualitative interviews. The web questionnaire is thus largely constructed around the perception of stress on the farming system and relative advantage of a new practice or production system, as these processes were found to be central to the participants' decision-making. The following chapter will present the results of this web questionnaire.

6 Quantitative results

This chapter presents the quantitative results from the web questionnaire (Appendix E). The web questionnaire was built around central themes derived from the analysis of the factors and drivers behind participants' decision-making in the qualitative phase of the study. The quantitative data will thus be used to support or reject the major concepts that emerged in the interviews while providing a more comprehensive picture of what options are being considered and why by a greater number of dairy farmers. The quantitative data was thus not used specifically to test the conceptual framework in Figure 11, as this was predominantly done through the qualitative phase of the mixed-methods approach.

The structured web questionnaire was distributed primarily online as described in Section 4.2. and was active for 50 days from November 12th to December 31st 2018. A total of 182 responses were recorded during this time. No partial completions were recorded. One response was eliminated as the respondent was not from New Zealand, and another was eliminated as the respondent had answered no questions but had submitted the response at the end of the questionnaire. Seven respondents were identified as having participated in the qualitative phase of this research and were, hence, also eliminated from the sample in order to avoid duplication. Therefore, the total number of analysed responses was 173. It is not possible to present a response rate since it is impossible to know how many dairy farmers were reached due to the three means of recruitment outlined in Section 4.2.2 on recruitment and collection.

The reason that seven respondents could be identified as participants is because they left their email addresses at the end of the questionnaire. This was optional and therefore there is a possibility that other responses could have been submitted from farmers that were interviewed for the qualitative part of this study. There is thus a possibility that some duplication has occurred. Apart from eliminating the responses from those that could be identified from their email addresses as having taken part in the qualitative phase of the study, nothing could be done to reduce the impact of potential duplicate respondents.

This chapter is structured as follows: First, some of the key characteristics of the respondents will be described and, where possible, compared to the general dairy farming population. Second, an outline of the respondents' current and desired future production systems will be described, as well as the reasons behind their choice of system. The respondents' attitude towards and reasons for choosing different value-added products, choice of dairy company, and different income streams will also be outlined. Third, the respondents' perceptions of the dairy industry will be presented as these were found to be intimately connected to threat appraisal in the qualitative

phase of the study. Finally, some qualitative analysis of the three final open-ended questions will be presented. These questions aimed to explore coping appraisal by examining the respondents' suggestions as to how their current or future farming system could be made easier to manage or more possible to reach, and how they would improve the dairy industry if they could choose freely.

6.1 Description of respondents

At the beginning of the questionnaire, respondents were asked some personal and farm-specific questions. The personal questions related to gender, their background in dairy farming, their position on the dairy farm, education level, and family situation. The farm-specific questions related to the respondents' location in New Zealand, their dependence on irrigation, their stocking rate and number of cows.

Out of 173 respondents, 168 answered the questionnaire on their own (45% female, 54% male, 1% preferred not to say). The remaining five respondents answered the questionnaire together with their spouse or partner. The spread between female and male respondents is fairly even with a slightly higher proportion of males.

Of 172 respondents, 46% had dependent children, 24% had no children, 21% had grown-up children and 9% have grandchildren (Figure 14). This question was deemed to be relevant as it may tell something about the priorities and stresses of the respondents since these often change after having children. Having children may affect respondents' perceptions of the dairy industry and influence their reasons for choosing a particular farming system, as was evident in the interviews with agroecological participants in the qualitative phase of the study.

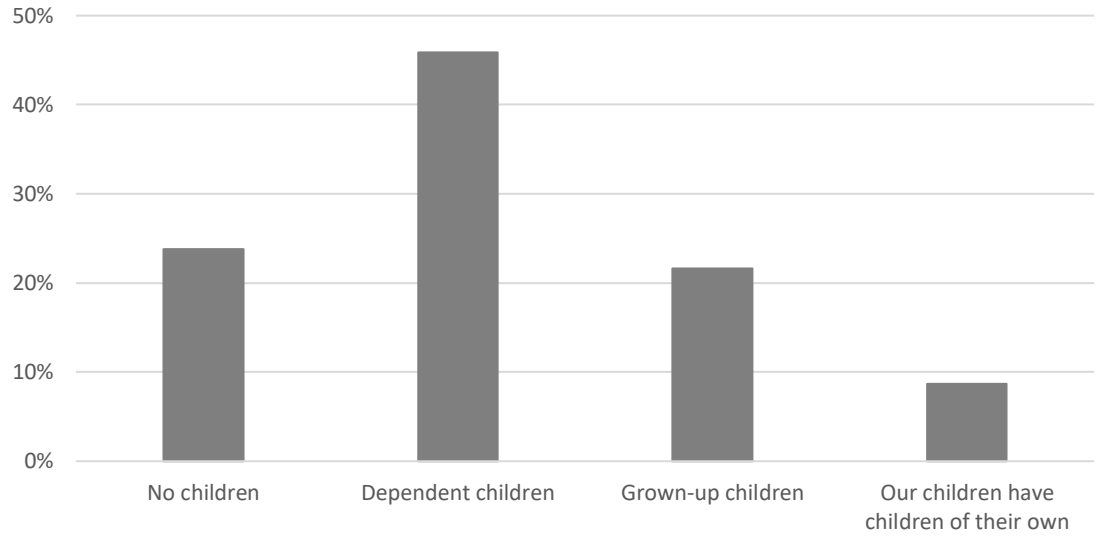

Figure 14. Family situation of respondents.

Education was included in the questionnaire in order to see whether this form of external knowledge influenced the choice of production system or perceptions of the dairy industry. A spread of educational backgrounds is evident from Figure 15. The largest group (43%) had a university degree (most often in the agricultural sciences and commerce, but also in business management, the arts and education). The second largest group (29%) had trades qualifications, such as an ITO course in agriculture or dairy, but also teaching, nursing and carpentry were represented. The third-largest group (22%) had completed secondary school. Two respondents' highest level of formal education was primary school, and nine respondents selected 'Other', in which professions such as pilot, artificial insemination technician, and graphic designer were listed.

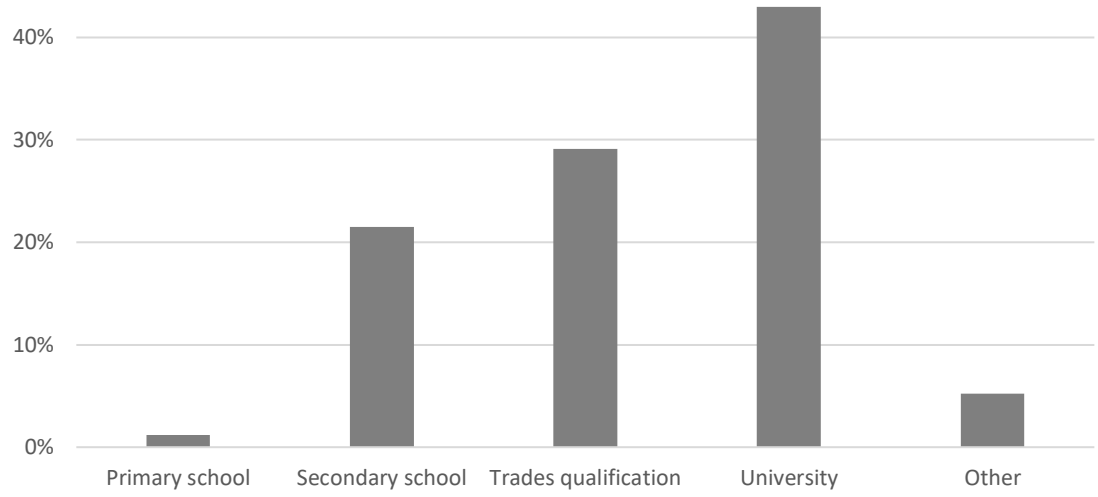

Figure 15. Type of education completed by respondents.

There was also a spread of job positions on farm among respondents (Figure 16). The largest group were farm owner-operators (28%). A similar amount of managers and sharemilkers made up the next two largest groups, at 20% and 17% respectively. The fourth-largest group (11%) were the contract milkers. A further 9% were farm owners who employed either a sharemilker or contract milker. The last two groups were farm workers (6%) and equity partner arrangements (5%). Six respondents who answered that they lease a farm or lease out their own farm (and one consultant) were grouped into 'Other'.

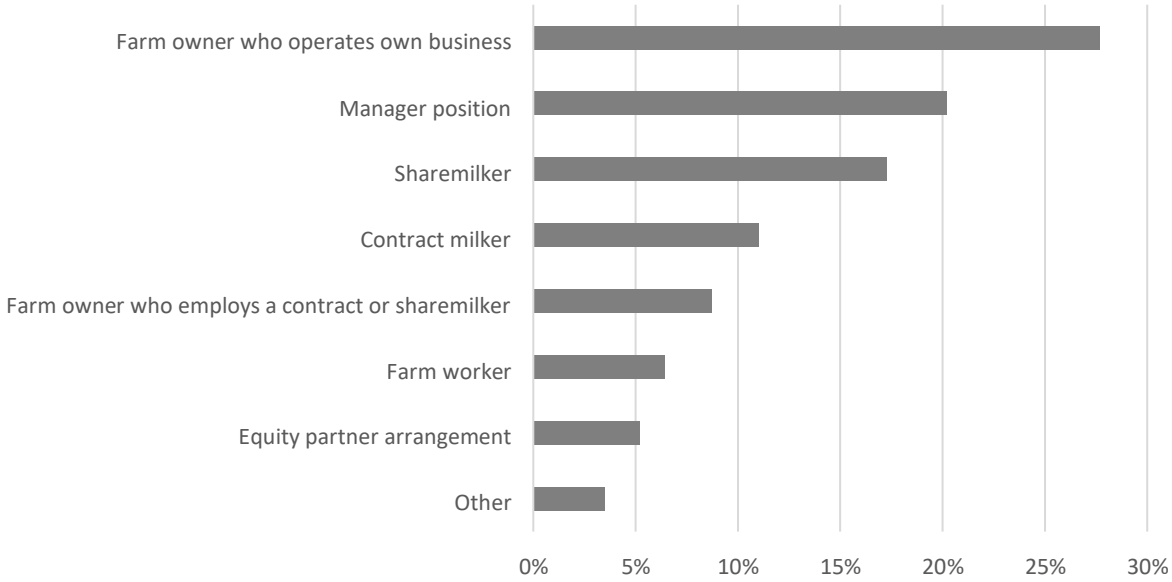

Figure 16. Job position on farm among respondents.

In the 2017/18 dairy season, about 60% of New Zealand dairy herds were managed by owner-operators, 27% under sharemilker agreements, and 13% by contract milkers (DairyNZ, 2018a). Farm workers and managers are excluded from DairyNZ's calculations. To calculate a percentage based on only these three groups for this study, equity partner arrangements were grouped as owner-operators because they operate the farm as if they owned it, although the farm may be partly bought with money supplied by an equity partner. Excluding farm workers and managers, the sample is represented by 54% owner-operators, 28% sharemilkers, and 18% contract milkers. This suggests that the distribution of respondents' position on farm is largely similar to the distribution of the wider dairy farming population in Aotearoa New Zealand.

As prior experience has a major influence on how individuals' choose to conduct their lives, it was appropriate to ask respondents about their background in dairy farming. A farmer who has grown up on a farm will have different experience and knowledge than a farmer who has learnt farming by attending university, for example. For example, the former might choose a management system that he or she is familiar with from when they grew up, whereas the latter might choose a system that was recommended by the teachings at his or her university.

As would be expected, most of the respondents grew up on a dairy farm (n = 75 or 43%). A non-negligible proportion of the sample (n = 54) selected that they worked in another occupation prior to dairy farming, and twenty respondents reported that they worked in another aspect of agriculture prior to dairy farming. Out of these twenty, eight either grew up or previously worked on sheep-only or sheep and beef farms. Horticulture and cropping, as well as rural banking, were also represented. Under 'Other' (n = 21), nine reported growing up on sheep (or sheep and beef,

or sheep and cropping) farms or having converted their farm to dairy from dry stock farming. Four reported marrying into dairying and others were accountants, butchers, teachers and bankers.

Due to the high number of respondents who selected 'Other' and the high number of respondents having grown up on or worked on sheep farms prior to entering into dairy farming, the respondents were grouped into five non-mutually exclusive categories – Raised on a dairy farm, Other occupation prior to dairy farming, Grew up rurally among dairy farmers, Went into dairy farming after education, and Sheep farmer prior to dairy farming. Figure 17 below shows the frequency of each response. In the questionnaire, it was possible to choose between two categories of having worked in other occupation and other agricultural occupation. Due to their similarity, these groups were merged into one creating the second largest group (n = 66). The two groups 'Grew up rurally among dairy farmers' and 'Went into dairy farming after education' were of similar size (n = 29).

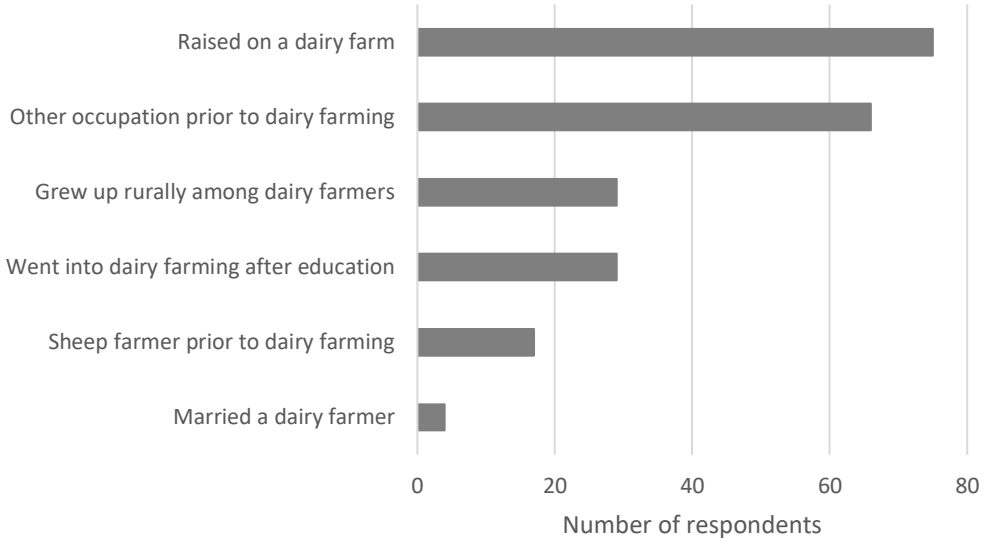

Figure 17. Background in the dairy industry of respondents in frequencies.

Location was asked as this has bearing on both regulations imposed by regional councils, as well as having differences in rainfall, soil type, temperature and other climatic factors that can affect farming. The respondents' location according to dairy farming regions was compared to the percentage distribution of herds in the year 2017/18 as reported by DairyNZ (2018b) in Table 8. Almost 30% of respondents resided in the traditional dairy farming region of Waikato. Other traditional dairy farming regions, such as Manawatu (13%), Southland (9%), Taranaki (7%), and Northland (7%), were also heavily represented. Together, these regions represent where 72% of respondents lived.

Manawatu is likely overrepresented in this sample because the sampling strategy involved repeatedly posting a message on the Manawatu Dairy Discussion Group on Facebook asking their

members to take part in the survey. Taranaki is underrepresented in this study (7%) compared to the wider dairy farming population (14%). The three regions Auckland, East Coast, and Western Uplands are not represented in this sample, but this is not very surprising as they are also the smallest of the dairy farming regions in New Zealand. Hawkes Bay, however, also has a small herd population but is overrepresented in this sample. These are all variations from the wider dairy farming population and need to be kept in mind when analysing results where geographical location could be an influential factor.

	Region	This study	Wider dairy population
North island	Northland	6.9%	7.4%
	Auckland	0.0%	3.3%
	Waikato	29.5%	28.7%
	Bay of Plenty	6.4%	4.8%
	Central Plateau	1.2%	4.2%
	Western Uplands	0.0%	0.8%
	East Coast	0.0%	0.1%
	Hawkes Bay	1.7%	0.6%
	Taranaki	6.9%	14.0%
	Manawatu	12.7%	4.7%
	Wairarapa	3.5%	3.7%
South island	Nelson/Marlborough	2.9%	1.9%
	West Coast	1.7%	3.2%
	North Canterbury	5.8%	7.5%
	South Canterbury	6.9%	2.7%
	Otago	4.6%	3.8%
	Southland	9.2%	8.5%

Table 8. Location of respondents in this study compared to DairyNZ (2018b) grouped by North and South Island.

Other farm-specific questions included reporting the number of cows each respondent had as well as their current stocking rate. The average stocking rate was 2.9, and the average number of cows was 523. These numbers are fairly similar to those of the wider dairy farming population, where 2.8 is the average stocking rate, and 431 is the average number of cows (DairyNZ, 2018b). The difference in the average number of cows appears to be a result of an overrepresentation of respondents operating large farms. Of the 25 respondents with the greatest number of cows, nine lived in North and South Canterbury, five in the Waikato, three in Southland, three in the Manawatu, two in Otago, one in Northland and one in Hawkes Bay. Less than half of respondents (82 out of 173) had a herd size larger than 431, but 52 of these had a higher number of cows than the South Island average of 635 (in the North Island, the herds tend to be smaller with an average herd size of 352 (DairyNZ, 2018b)). Thirteen of the respondents had more than 1000 cows, including four who had nearly 2000 cows each. These are likely to have skewed the average

number of cows upwards for this sample. This might affect the results to represent larger farms than the average in New Zealand.

It is impossible to assess whether the sample of respondents is biased based on analysis of the key characteristics of respondents and, where possible, comparison to that of the wider dairy farmer population. Although the spread of position on farm and location seem reasonably similar to the wider dairy farming population, it was not possible to establish whether gender, family situation, background in dairy farming, or type of education in the sample were good representations. This lack of information means that it remains likely that the respondents are not representative of the wider dairy farming population. Although the results of this survey cannot, therefore, be said to show the motivations and aspirations of the wider population, it provides an enlarged base of information that can be used to support or reject the data from the qualitative interviews.

6.2 Comparisons between current and future management systems

It was essential to compare the respondents' current farming system with their desired future farming system to find out what, if anything, they wished to change. Out of 173 respondents, 95 (55%) actively selected 'I have an ideal future farming system towards which I strive', and 74 (43%) selected 'I do not think that my current farming system will change much going forward'. Four respondents did not select either alternative, but could still answer the 'Future farming system' section of the questionnaire if they chose to. These respondents answered the questions to varying degrees, which is the reason why the number of respondents varies between 95 and 99 for these questions. The respondents who did not wish their current system to change in the future were not able to answer the questions pertaining to future farming systems.

The following two sections (6.2.1. and 6.2.2) compare data from all respondents who answered questions on their current management system and those respondents who answered questions on their future management system. Due to the discrepancy in sample size between those in the current and the future subgroups, some of the results below are presented in percentages in order for direct comparisons to be made more easily. The management practices analysed include production system, milking frequency, value-add options and dairy companies, DairyNZ system, and income streams. This was designed to reflect the diversity of practices and production systems that participants in the qualitative phase of the study have adopted or were considering to adopt as shown in Table 6 in Chapter 5.

Kruskal-Wallis tests were generally conducted for both current and potential future farming system aspects. The respondents were able to select how relevant the reasons were for their choice of current and future system using a five-point Likert-type response format where 1 = Not

relevant/Does not describe my system, 2 = Slightly relevant/Slightly describes my system, 3 = Moderately relevant/Moderately describes my system, 4 = Strongly relevant/Mostly describes my system, and 5 = Extremely relevant/Clearly describes my system. Respondents had 23 reasons to rank for their choice of current system, and 18 reasons to rank for their choice of ideal future system. All tests were corrected for tied ranks.

6.2.1 Current production system

To understand the distribution of systems currently employed among the respondents and to understand whether some respondents had already changed systems in the past, one question asked respondents to define their system using the following different options: Always conventional, always biological, always organic, always biodynamic, certified organic, organic but not certified, certified biodynamic, biodynamic but not certified, used to be conventional but now biological, used to be conventional but now organic, used to be biological but now conventional, used to be biological but now organic, used to be organic but now conventional, and used to be organic but now biological. The four production systems were described in the question to facilitate understanding of the different options and were defined as:

- **Conventional** or industrial agriculture refers to farming systems which typically include the use of any or all of the following: synthetic chemical fertilisers, pesticides, herbicides, other continual inputs, irrigation, and tillage. Thus conventional agriculture is typically highly resource- and energy-intensive, but also highly productive.
- **Biological** or regenerative agriculture includes a reduction or complete absence of use of synthetic chemical fertilisers towards a focus on biological fertilisers that enhance soil biology. Practitioners often see biological farming as a middle-way between a conventional and an organic system and aim to achieve better plant and animal health through improved soil health. No certification is available.
- **Organic** typically means farming without synthetic fertilisers and pesticides. Instead, it relies on crop rotation, animal and plant manures as fertilisers, some physical and biological weeding and pest control. Certification can be obtained through BioGro and AsureQuality.
- **Biodynamic** is similar to organic but uses locally sourced material for use as fertilisers and soil conditioners. Practitioners view the farm as a closed diversified ecosystem, and often base farming activities on lunar cycles. Certification can be obtained through the Bio Dynamic Farming and Gardening Association.

Respondents could select more than one option and could also further specify their system by writing in a textbox. The three largest groups were conventional (76% of respondents), used to be conventional but now biological (11%), and used to be conventional but now organic (5%) (Table 9). Of the 28 who used to be conventional, 19 (68%) had become biological and 9 (32%) had become organic. Only one respondent selected one of the three options relating to biodynamic production and identified as being biodynamic but not certified. Another respondent selected 'used to be organic but now conventional'. This respondent also reported aiming for a biological system in the future but that financial capital is required to reach this goal.

Current production system	**Number of responses**	**Percentage of total responses**
Always conventional	132	76.3
Used to be conventional but now biological	19	11.0
Used to be conventional but now organic	9	5.2
Other	8	4.6
Certified organic	7	4.1
Always biological	7	4.1
Always organic	5	2.9
Organic but not certified	4	2.3
Used to be biological but now organic	3	1.7
Biodynamic but not certified	1	0.6
Used to be organic but now conventional	1	0.6
Used to be organic but now biological	1	0.6
Certified biodynamic	0	0
Always biodynamic	0	0
Used to be biological but now conventional	0	0

Table 9. The 15 different options that could be chosen by respondents to describe their current production system.

Another selected two options saying that she used to be conventional but converted to organic and that she used to be organic but is now biological. She wrote that their milk is organic but that no dairy company in their area would pick it up as organic milk.

Each respondent could select all options that applied. To group them for analysis, however, each respondent's choice(s) had to be evaluated individually and assigned a group based on their overall current farming method (see classification system in Table 10 below). For instance, a respondent who selected both 'organic but not certified' and 'used to be conventional, now biological' was grouped into 'Biological'. All biodynamic options were grouped into 'Organic' seeing as it can be

assumed that they adhere to the organic principles; biodynamic production has stricter rules than organic production as explained in Section 2.2.2. The respondents who had written specific information about their system under 'Other' had to be individually assigned as well. Those who wrote 'combination of conventional and biological', 'moving from conventional to biological', 'always conventional but try and apply biological principles where possible', and 'but with biological emphasis' were placed in the Conventional group, as their description seemed subjectively more akin to a conventional system than a biological system. It was important to approach the grouping conservatively so as not to overestimate the number of respondents who are operating alternative production systems, and vice versa.

Current production system	**Assigned group**	**Percentage of respondents**
Always conventional Used to be biological but now conventional Used to be organic but now conventional Other • Combination of conventional and biological • Moving from conventional to include biological • Always conventional but try and apply biological principles where possible • But with biological emphasis (also selected 'Always conventional')	Conventional	78.6%
Always biological Used to be conventional but now biological Used to be organic but now biological Other • Minimal inputs, almost biological • Mostly conventional, trialling biodynamic on 10% of farm (also selected 'Used to be conventional but now biological) • Regenerative, holistic	Biological	12.7%
Always organic Always biodynamic Certified organic Organic but not certified Certified biodynamic Biodynamic but not certified Used to be conventional but now organic Used to be biological but now organic Other • Currently organic and biological	Organic	8.7%

Table 10. Groups created from the current production system descriptions.

'Minimal inputs, almost biological' and 'regenerative, holistic' were placed in the Biological group, as the former is almost biological and the latter quite definitely is as they have written regenerative. A respondent who wrote 'mostly conventional, trialling biodynamic on 10% of farm' had also selected 'used to be conventional, but now biological', and was therefore also placed in the Biological group. Finally, one respondent who wrote 'currently organic and biological' was placed in the Organic group, as they have clearly stated that they are organic. An organic system is also biological, but a biological system does not have to be organic as described in Figure 3 in Section 2.2.3.

Out of 173 respondents, 79% were thus considered conventional, 13% were biological, and 9% were organic. The percentage of organic respondents is higher than the percentage of dairy farmers who are organic in New Zealand. Although it could not be established how many organic dairy farmers there are in New Zealand due to the unknown number of uncertified organic and biodynamic producers, the group most likely does not reach more than a few per cent (see Section 2.2.4 for further details). This overrepresentation is most likely due to the survey being circulated by the Organic Dairy & Pastoral Group (ODPG) in their network. The percentage of biological dairy farmers may be similar to that of the wider dairy population if the estimate provided by farmer and entrepreneur Roger Beattie is correct. He estimated that there might be between 10-20% biological farmers in New Zealand, although he did not specify an estimated percentage for dairy farming specifically (Beattie, 2019). Although this sample is not representative of the wider dairy farming population, we can appreciate the relatively high number of agroecological respondents, which makes it easier to conduct useful statistical analysis that can help to support or reject the findings of the qualitative part of this study.

Reasons for current production system between groups

As none of the data was normally distributed, a series of 23 Kruskal-Wallis tests were performed to compare the reasons behind the respondents' choice of production system. Ten reasons differed significantly between the groups conventional, biological, and organic at the 0.05 significance level (Table 11). To correct for family-wise error rate inflation, however, the *p*-value was adjusted to 0.002 (0.05/23=0.00217), leaving four reasons significantly different between the groups. These reasons were 'low environmental impact' (χ^2 (2, n = 167) = 39.402, $p < 0.001$), 'the use of this system can improve public perception'(χ^2 (2, n = 164) = 33.864, $p < 0.001$), 'the consumer wants this system' (χ^2 (2, n = 164) = 33.762, $p < 0.001$), and 'I feel good using this system' (χ^2 (2, n = 164) = 25.33, $p < 0.001$).

Pairwise comparisons for each of the four significant reasons showed that biological and organic respondents felt that these options reflect their choice of system 'A lot' to 'A great deal', whereas conventional farmers felt this 'Slightly' to 'A lot'. The difference between biological and conventional respondents, and between organic and conventional respondents was significant at ≤ 0.001 for all four measures. There were no significant differences between biological and organic respondents. Belonging to a production system group explained between 15% and 24% of the variation seen for these measures.

Reasons	Current system	Mean rank	Median	*p*-value	n	Effect size
Low environmental impact	Conventional	72.02	3	< 0.001*	167	23.7%
	Biological	120.73	4.5			
	Organic	133.93	5			
The use of this system can improve public perception	Conventional	71.11	3	< 0.001*	164	20.8%
	Biological	120.77	4			
	Organic	122.77	5			
The consumer wants this system	Conventional	71.19	2	< 0.001*	164	20.7%
	Biological	117.55	4			
	Organic	126.83	5			
I feel good using this system	Conventional	73.14	4	< 0.001*	164	15.5%
	Biological	114.14	4.5			
	Organic	121.85	5			

*Table 11. Reasons where conventional, biological and organic respondents differ significantly in their opinion of importance for their choice of current system. * = significant at the adjusted p-value 0.002*

Low environmental impact, improving public perception and consumer wants this system were all part of organic and biological respondents top five reasons for their current choice of system. These aspects are, however, more important to them than they are to their conventional counterparts. Interestingly, all three groups rated 'I feel good using this system' high (in the top five) even though conventional respondents rated it lower than the other groups. This shows a healthy level of wellbeing among respondents regardless of system. The difference in ranking could perhaps be due to the other reasons that differ between the groups but could also be related to completely different aspects discussed in the previous chapter, such as egoistic values such as spending time with dependent children. The reasons why these respondents feel better using their systems in comparison to conventional respondents was not possible to discern from the questionnaire. All groups rated 'good animal health' in the top five and showed no significant difference between them. Conventional respondents rated on average high profitability, system is flexible, and system is resilient to seasonal weather constraints in their top five reasons for choice

of current system. The emphasis placed on low environmental impact, improving public perception and consumer wants this system by agroecological respondents and the emphasis of the conventional respondents is thus revealing what they value about their current system.

6.2.2 Future production system

Of the 173 respondents who completed this survey, 96 respondents (56%) answered questions relating to an ideal future farming system. The other respondents were perhaps comfortable with their current system and did not have an ideal system in mind. Both groups are likely analysing how well their system is placed to handle current and potential future stresses, but the former group has already considered or made a clear decision on how to improve their system.

Table 12 below shows the distribution of those 96 respondents who have a future farming system towards which they strive. For this question, respondents could choose between six options: conventional, biological, certified organic, organic but not certified, certified biodynamic, and biodynamic but not certified. They were further allowed to write their own description under 'other'. Six respondents used this option and had to be assigned to one of the three overarching groups 'Conventional', 'Biological', and 'Organic'. Those who wrote 'regenerative' and 'holistic, regenerative' were placed in the Biological group because regenerative farming is thought to be a form of biological farming as described in Section 2.2.2. Those who wrote 'conventional with minimal tillage etc' and 'a combination of conventional and biological with the overarching principle of sustainability and adapting to physical, and societal realities' were grouped into Conventional, as their description seemed subjectively more akin to a conventional system than a biological system. Finally, one respondent who wrote 'biological organic certified' was placed in the Organic group, as it is only possible to be certified if you are organic. Out of the 96 respondents who had a future farming system towards which they strove, 38.5% wished to be conventional, 39.5% wished to be biological, and 22% wished to be organic.

Future production system	Number of responses	Assigned group	Percentage of respondents
Conventional Other • Conventional with minimal tillage etc. • A combination of conventional and biological with the overarching principle of sustainability and adapting to physical, and societal realities	36 2	Conventional	38.5%
Biological Other • Regenerative • Holistic, regenerative	37 2	Biological	39.5%
Certified organic Organic but not certified Certified biodynamic Biodynamic but not certified Other • Biological organic certified	9 4 2 3 1	Organic	22%

Table 12. Groups created from the future production system descriptions.

From the respondents' answers, it can be established that many of them were interested in an agroecological approach to dairy farming. Approximately half of the conventional respondents (47%) wished to adopt an agroecological system in the future, and these were generally more interested in a biological than an organic system. Further, approximately half of the biological respondents (35%) were in their turn interested in adopting an organic system in the future. Table 13 and Figure 18 below show the changes that the respondents wished to make. Of the currently organic respondents, only one wished to adopt regenerative practices within a biological system. Of those who are currently either biological or organic, none wished to convert to conventional production.

		Current system			
		Conventional	Biological	Organic	**Total**
Future system	Conventional	38	0	0	**38**
	Biological	27	11	1	**39**
	Organic	6	6	7	**19**
	Total	**71**	**17**	**8**	**96**

Table 13. The desired change of production system in the future.

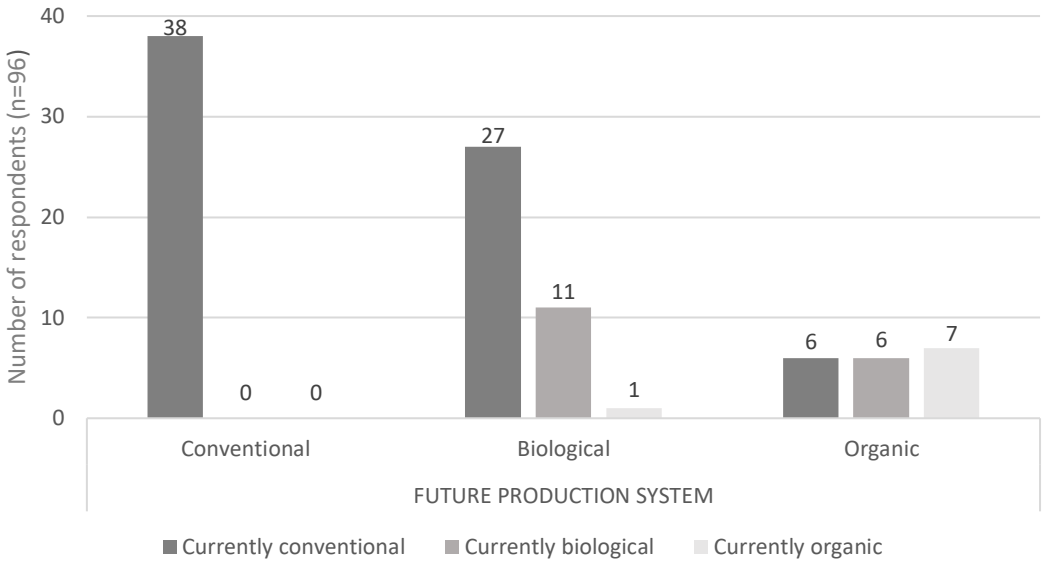

Figure 18. Bar chart showing which systems respondents who were currently either conventional, biological, or organic wished to adopt in the future.

A Fisher's exact test was conducted to see whether the changes seen can be statistically supported. The assumptions of a Pearson's Chi-square test could not be satisfactorily met as there were cells with counts less than five. The Fisher's exact test showed a non-random pattern of responses between the variables (χ^2 (n = 96) = 39.001, $p < 0.001$) with an effect size of 41%. The assumptions of the Pearson's Chi-square test could be met by combining organic and biological production systems into one group: agroecological. Comparing respondents' current and desired future production system showed a strongly significant trend, χ^2 (1, n = 96) = 22.15, $p < 0.001$, of respondents striving towards a more agroecological approach to dairy farming. It is also interesting to note that most of the current conventional and current biological respondents are happy with their choice of production system. This indicates that they are interested in tweaking their current system in other ways than switching from one production system to another. These tweaks could include moving to A2 milk, once-a-day milking, or reducing the intensity of the operation, and will be covered in depth further in later sections.

If all respondents would follow through and change to their desired future production system, the distribution of production systems would change. The conventional group would decline from 79% to 60%, the biological group would increase from 13% to 25%, and the organic group would increase from 9% to 16% (Figure 19). That would entail a reduction of conventional production systems by nearly 25% and would entail an almost doubling of organic and biological production systems in this sample group. For this analysis, those respondents who had not reported that they wished to change system in the future were recorded as keeping the system they had selected as their current system. Therefore, the total number of respondents for both categories was 173.

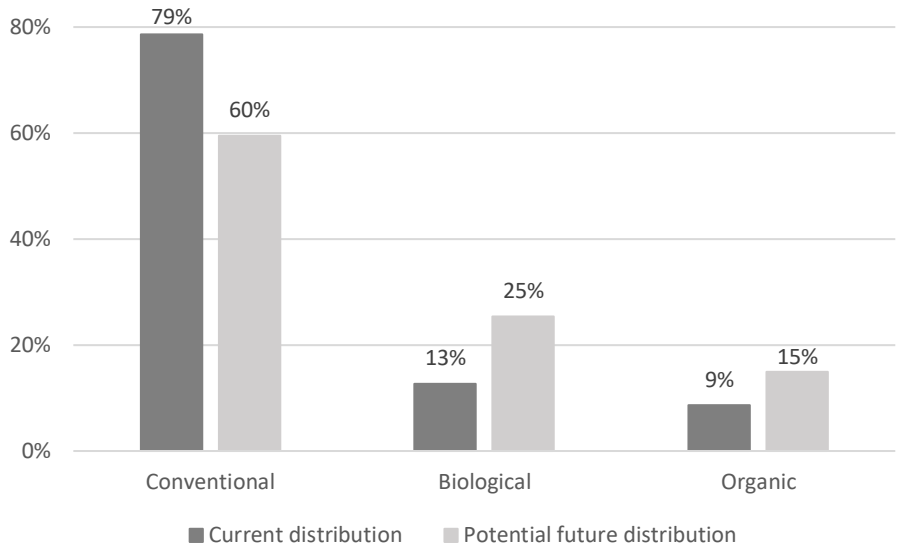

Figure 19. Bar chart showing the potential change in total distribution of the production systems conventional, biological and organic for the respondents taking part in the survey.

Combining the biological and organic groups to an agroecological group, we see that 103 (76%) out of 136 currently conventional farmers wish to continue conventional production, whereas 33 (24%) wish to adopt either a biological or an organic system in the future. The 37 respondents who are currently agroecological wish to continue agroecological production. The result of a Pearson's Chi-square test, for all 173 respondents, comparing their current and future chosen system, is a strongly significant trend, χ^2 (1, n = 173) = 69.26, $p < 0.001$, and shows that many respondents wish to move towards a more agroecological approach to dairy farming.

The data in Table 12 also show an interesting trend of farmers aspiring to become either organic or biodynamic without necessarily becoming certified. Of the 19 respondents who aspired to be either organic or biodynamic in the future, 14 (74%) wished to be organic, and 5 (26%) biodynamic. Of the 14 respondents who wished to become organic, 10 (71%) wished to become certified, while in the biodynamic subgroup, only 2 (40%) wished to become certified.

Reasons for future production system between groups

To compare the 18 different reasons offered to participants when asked to rank their reasons for choosing a different future system, Kruskal-Wallis tests, adjusted for ties, were performed. Six reasons differed significantly in importance among the three production groups at the 0.05 significance level (Table 14). To correct for family-wise error rate inflation, however, the *p*-value was adjusted to 0.003 (0.05/18=0.00277), leaving three reasons significantly different between groups. These reasons were 'lower environmental impact' (χ^2 (2, n = 92) = 17.310, $p < 0.001$), 'the consumer wants this system' (χ^2 (2, n = 92) = 15.820, $p < 0.001$), and 'the use of this system can improve public perception' (χ^2 (2, n = 90) = 13.059, $p = 0.001$). These reasons were also significant

for the choice of current system as described earlier. 'I feel good using this system' was shown to be significantly different between groups in the 'Current farming' section of the questionnaire, but this particular reason was not offered in the 'Future farming' section.

Pairwise comparisons for each showed that future organic farmers stated that these options reflected their choice of system significantly more than future conventional farmers. Respondents who in the future wished to be biological were not significantly different from the other two groups. Only when ranking 'lower environmental impact', did the biological group get close to being significantly different from the conventional group at $p = 0.055$. Belonging to a production system group explained between 14 and 19% of the variation seen for these measures.

Reasons	Ideal future system	Mean rank	Median	*p*-value	n	Effect size
Lower environmental impact	Conventional	35.17	4	< 0.001*	92	19%
	Biological	48.72	5			
	Organic	63.66	5			
The consumer wants this system	Conventional	35.61	4	< 0.001*	92	17.4%
	Biological	48.72	4			
	Organic	64.33	5			
The use of this system can improve public perception	Conventional	36.06	4	0.001*	90	14.7%
	Biological	46.81	4			
	Organic	61.78	5			

*Table 14. Reasons where conventional, biological and organic respondents differ significantly in their opinion of importance for their choice of future system. * = significant at the adjusted p-value 0.003.*

It is interesting to note that, while there were significant differences between current conventional and current biological respondents, there are no significant differences between future conventional and future biological respondents. Rather than the biological respondents being less certain of the benefits of their ideal future system, the conventional respondents seem more convinced of the benefits of their ideal system. Lower environmental impact as well as improved animal health was in the top five reasons for choice of future farming system for all three groups indicating that these aspects are particularly important when choosing a future farming system regardless of production system. Biological and organic respondents both ranked improving public perception and being able to capitalise on available premiums/value-add in their top five. This is interesting as there is no premium available for biological production. At this point, it is important to note that the future farming system described by each respondent is not only about the different production systems, but also about milking frequency, value-add and additional income streams, dairy company, and DairyNZ system. It could, for instance, be the case that capitalising

on available premiums/value-add was scored high for biological respondents because they simultaneously wish to supply grass-fed only or A2 milk. It is therefore essential to look at the total picture of the respondents' ideal future farming system rather than just production system in order to understand the changes they wish to implement and why. These aspects of the farming system will be presented and discussed in the next sections.

Change in milking frequency

A majority of respondents (55%) are currently milking twice per day all season. The second-largest group (37%) use combinations of twice-a-day, 16 hrs, and once-a-day as the season progresses, whereas those who milk once per day are in a minority (8%). The respondents who have indicated that they want to change their system in the future are however more keen to milk once per day all season instead (32%). The largest group (42%) wish to use combinations of twice-a-day, 16 hrs, and once-a-day as the season progresses. The smallest group (26%) wish to milk twice per day (Figure 20). Farmers who use combinations of twice-a-day, 16 hrs, and once-a-day as the season progresses, usually report that they go down in milking frequency after Christmas or early in the year when it gets dry and grass growth decreases. In contrast, one couple explained that they currently milk thrice-a-day using robots and intend to continue this in the future while housing cows indoors.

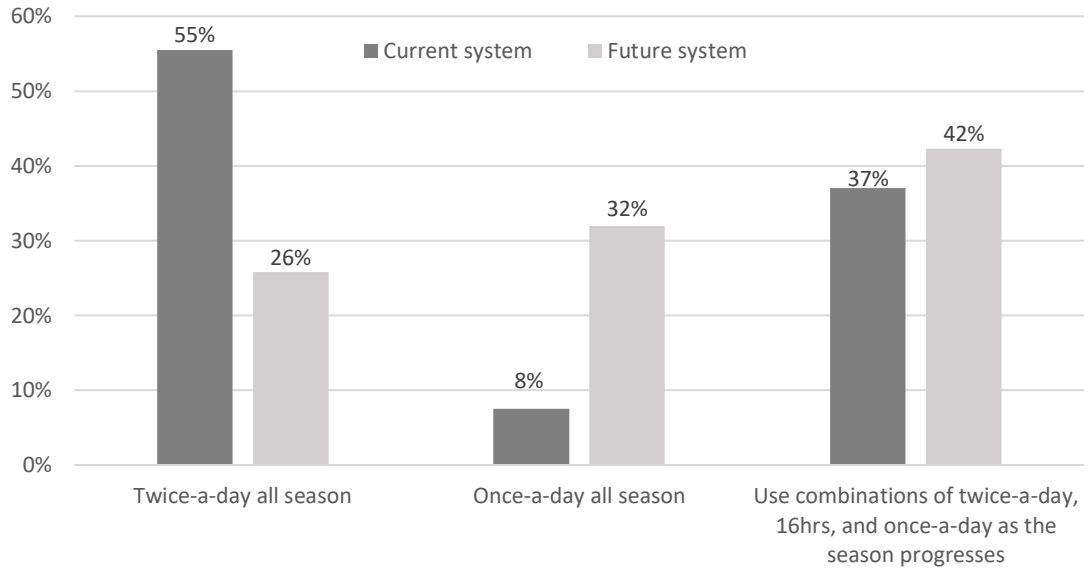

Figure 20. Current and future milking frequency.

A similar series of Kruskal-Wallis tests were conducted to examine whether there were any particular reasons for the respondents' choice of system that were related to how often they currently milk and how often they would like to milk in the future. Testing both current and future reasons, none of the tests was statistically significant at the adjusted *p*-level. This indicates that

production system accounts for a larger variation seen in responses than change in milking frequency for these respondents.

Change in value-added products and dairy company

It is exciting to examine what type of value-added dairy products farmers might be interested in producing in the future as this might dictate which dairy company they choose to supply. Many farmers (57%) who were thinking about changing their system were interested in supplying A2 milk in the future (Figure 21). Some wrote under the option 'other' that they currently could produce A2 milk but that the company they supply does not pick up in their area or is currently not offering a premium for it. Two other notable aspirations are to supply grass-fed only (49%) and raw milk (41%) in the future.

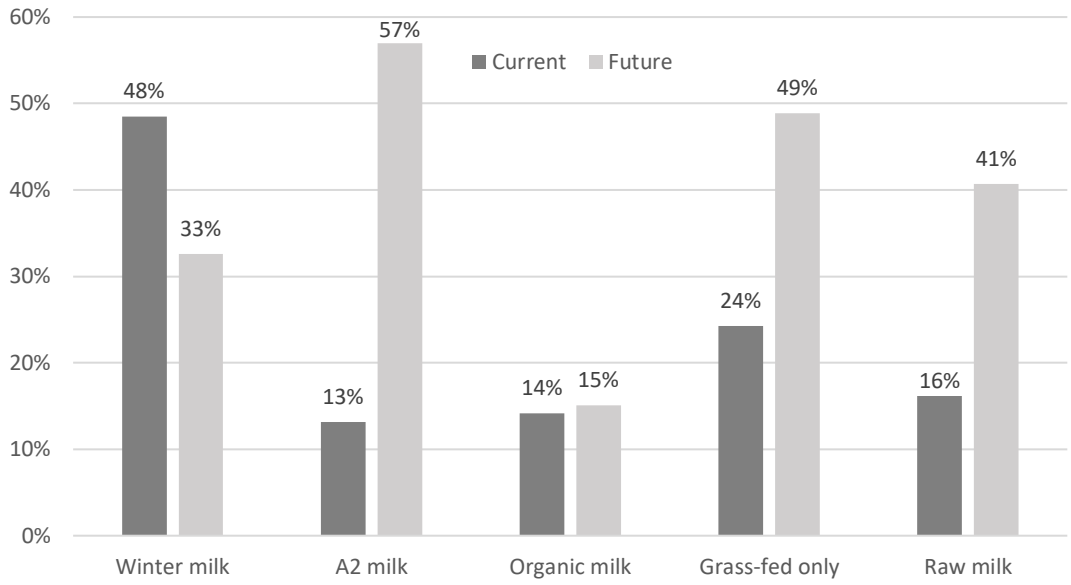

Figure 21. Current and future options for supplying value-added products.

It was clear that three value-add options were particularly desirable to respondents who indicated that they want to change their system in the future: A2 milk, grass-fed only, and raw milk. A series of Mann-Whitney U tests were conducted to investigate what reasons respondents had for choosing these options. It was not possible to analyse between groups because respondents were able to choose more than one option. Many respondents also chose several options for their future system, as can be seen from Figure 22.

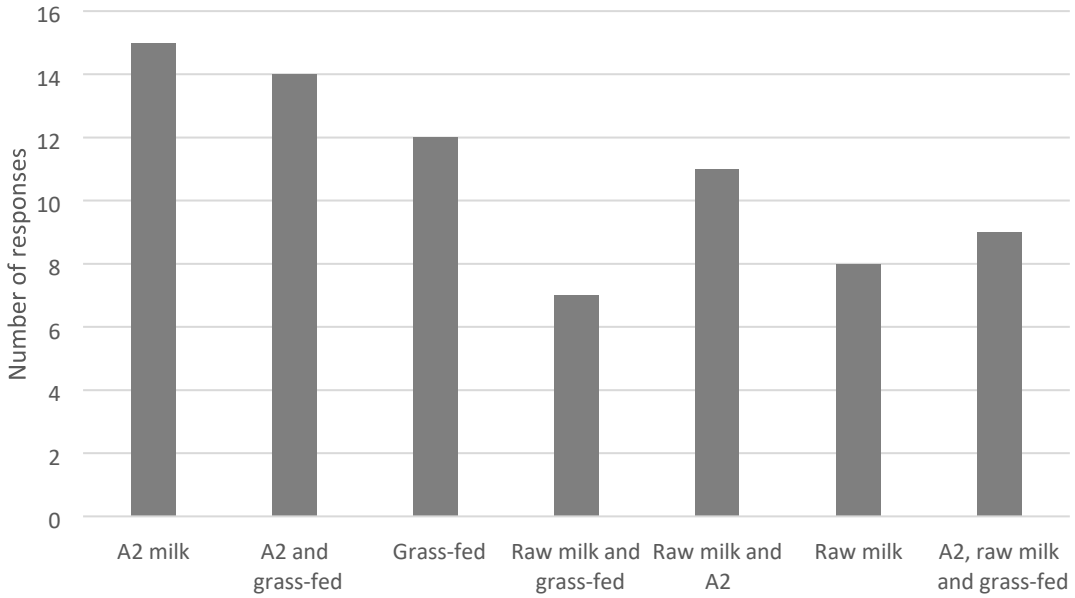

Figure 22. Number of responses for each value-added product from respondents describing their ideal future system.

A Mann-Whitney U test, corrected for ties, indicated that 'lower cost' was significantly more a reason for those planning on producing grass-fed only milk than those who do not (U = 674.5, p = 0.001). This makes sense, as growing grass and cutting silage to feed your cows on farm can be cheaper than buying in feed from outside the farm. This also ties in with the participants' endorsement of growing grass to reduce costs and improve profitability described in the interviews. None of the other Mann-Whitney U tests revealed any significant differences between groups in reasons for choosing A2 milk (or not), grass-fed only (or not) or raw milk (or not), at the adjusted *p*-level.

There is an indication that many respondents are interested in supplying smaller companies than Fonterra in the future, which perhaps could be connected to Synlait's existing premiums for A2 and grass-fed only milk. Currently, Synlait is the only dairy company that offers a premium to farmers who produce grass-fed milk. Westland Milk Products in partnership with Southern Pastures are also selling grass-fed milk but whether the farmers receive a premium for that product is unclear.

A great majority (79%) of respondents currently supply milk to the cooperative Fonterra. The other large dairy companies Open Country, Synlait and Westland Milk Products, were represented with 12%, 4% and 2% respectively. A small percentage of respondents supplied milk to other dairy processors such as the Organic Dairy Hub, Tatua or processed their milk independently. The respondents who indicated a potential future change to their system were, however, planning to a greater extent to process their milk independently (16%), or move to either Synlait (15%) or Open Country (19%). The majority were, however, planning to stay with Fonterra as their processor

(56%). This projected change of market share between dairy companies is supported by TDB Advisory (2019) described in Section 2.3.2. Fonterra has since early 2018 also embraced A2 milk and might in the future offer a premium to their suppliers (Fonterra, 2018a).

No significant reasons were identified when looking at those who indicated that they wish to produce raw milk in the future. Under current MPI regulations, supplying raw milk to consumers is fraught with bureaucratic hurdles to overcome. It was expected that market access would have been an issue for this group in accordance with indications from the interview participants who produced raw milk. The advantage of producing raw milk is, however, that dairy farmers can set their own market price as an independent processor and producer. Indeed, when respondents were asked what other income streams they might want to maintain or develop, 39% selected selling their own produce on farm or in town. Results show that 66% of these respondents also selected raw milk as a future value-added product they want to produce. One would almost expect that those who selected raw milk as a future product to produce would also select that they want to direct market their product as it is only possible to sell raw milk at the farm gate according to current MPI rules. A reason for this difference might either be a result of the question being unclear or that respondents are not aware of this rule. The former might be because all dairy farmers technically produce raw milk although it is sold to processors to market.

Change in income streams

Sixty per cent of all respondents selected that they currently have extra income streams aside from dairy farming. Of those who had a future farming system towards which they strove, 84% (83 out of 99) indicated that they wished to include additional income streams. It is clear that diversification is of interest, potentially to improve profitability or avoid having all eggs in one basket. Seventy per cent of respondents selected supplying beef as their additional income stream. This was followed by 46% who were interested in letting a Wagyu or Hereford bull go with the cows after artificial insemination in order to be able to sell four-day-old calves as veal in the case of unsuccessful insemination. Selling one's own produce was the third most selected option but saw the greatest change. Only 5% of all respondents currently direct market their own produce whereas 39% are interested in doing this in the future. Direct marketing could be a way to increase control of and shorten the supply chain, and dictate your own market price and hence improve the bottom line. Relying on a milk price set on the international market and by the company you supply could be seen as riskier. Other suggestions from the respondents included stud sales, cropping, lamb, bull servicing, horticulture, forestry, and poultry. This suggests that diversification of income streams is important to farmers going forward as a means of spreading the risk between ventures.

Change in DairyNZ system

DairyNZ has defined five systems based primarily on whether and when imported feed is fed to dry or lactating cows throughout the season, and the amount of imported feed and off-farm grazing. The systems are outlined below.

System 1 All grass self-contained, all stock on the dairy platform. No feed is imported. No supplement fed to the herd except supplement harvested off the effective milking area and dry cows are not grazed off the effective milking area.

System 2 Feed imported, either supplement or grazing off, fed to dry cows. Approximately 4-14% of total feed is imported.

System 3 Feed imported to extend lactation (typically autumn feed) and for dry cows. Approximately 10-20% of total feed is imported.

System 4 Feed imported and used at both ends of lactation and for dry cows. Approximately 20-30% of total feed is imported onto the farm.

System 5 Imported feed used all year, throughout lactation & for dry cows. Approximately 25-40% (but can be up to 55%) of total feed is imported.

(DairyNZ, 2019a)

These systems are important to investigate as they vary in their dependence on imported feed and the costs that buying the feed incur. Figure 23 shows that there appears to be a trend towards wanting to operate dairy farming under lower DairyNZ systems such as Systems 1 and 2 in the future. This indicates that many respondents wish to become more self-contained and less reliant on imported feed from suppliers and other farms. Lower cost was also a significant reason mentioned by respondents wishing to go grass-fed only in the future, as described previously.

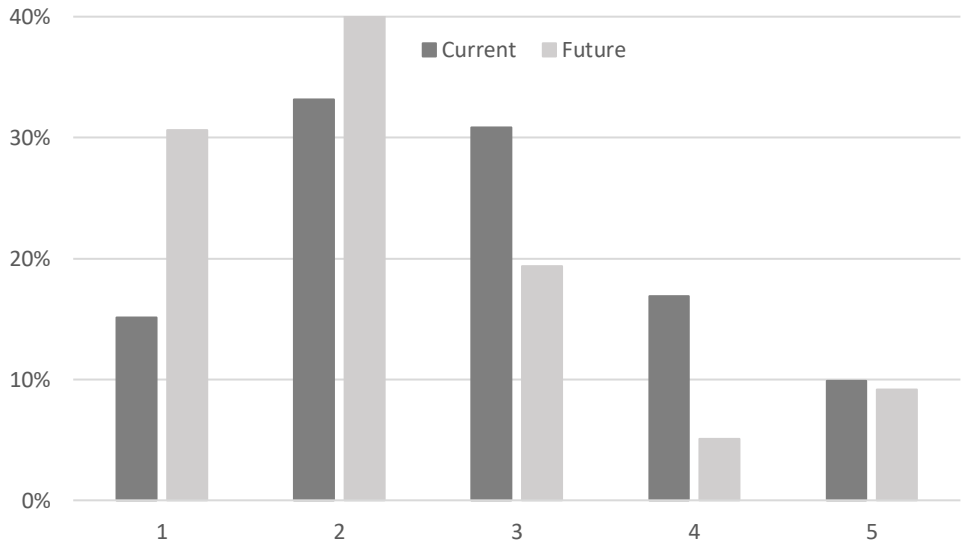

Figure 23. Current and future DairyNZ system where system 1 is more self-contained and system 5 is more dependent on imported feed.

The potential changes in milking frequency, value-added products, dairy company, income streams, and DairyNZ system outlined above highlight that there are several more options, aside from overall production system (conventional, biological, and organic), that respondents are interested in. The results from these analyses show that choice of overall production system explains more of the variation seen than any of these factors. The only factor that was significant at the adjusted *p*-level was 'lower cost' for the choice of future grass-fed only products. The reasons highlighted as important for deciding on adopting an agroecological system or not are perceptions that the operation of those systems have a lower environmental impact, improves public perception, and is desired by consumers. Other reasons were also found to be indicative of which system respondents' chose but were not significant at the adjusted *p*-level.

Additional reasons for selecting current and future farming system

Respondents also had the option of adding other reasons than those offered in the questionnaire. Out of 33 additional reasons added by 23 respondents for the choice of current system, nine stated that they had no choice in how their current business was run. Five were contract milkers, two leasees, one farm worker, and one sharemilker. People in these job positions often have a limited say in how the farms they work on are operated on an overall system level as described in Section 4.1.1. One respondent wrote *"If we owned the farm, we would manage it in a more biological way, more self-contained and less inputs".*

Other reasons for choice of current system was that it matched their values (three respondents), was deemed more environmentally sustainable and resilient (three respondents) and was good for staff (two respondents).

One conventional farmer explained that the following two reasons were extremely relevant for his choice of a once-a-day, grass-fed only system:

> *"I operate a full season OAD [milking once a day] system because I believe it to be sustainable and resilient heading into the future. I also believe it has intrinsic values that have yet to be acknowledged by the wider industry, such as satisfying discerning consumer demand for a natural nutritionally dense milk from relatively healthy, happy, well cared for cows."* and
>
> *"[The farm] lends itself well to grass only farming with no reliance on external inputs. The future for NZ dairy exports looks unstable without recognition of the need to globally differentiate our milk based on our traditional strength of grass only farming. The intrinsic value in this has shifted from 'low cost production' to 'authentic high value nutrition' due to increasing consumer perception of the difference and benefits of grass sourced dairy."*

The quotes highlight consumer awareness and demand for high-quality products as a driver for this respondent. Not only does this respondent feel that his chosen system has intrinsic value but also that it is a system that is more stable and resilient. These sentiments were also echoed by the participants taking part in the semi-structured interviews, as described in the previous chapter.

That producing a higher quality product is an important reason, was also echoed by one biological respondent who indicated that his system will change going forward into the future. Among the 16 added reasons for the choice of future system, being good for staff and work-life balance as well as being enjoyable and challenging were also mentioned indicating that wellbeing is highly valued. One respondent wishing to operate a DairyNZ system 5 explained how she sees their system as environmentally sound.

> *"As a 'system 5' farm might be perceived as bad for the environment, but we grow 90% of supplements on farm and find a good a balanced diet will significantly reduce nitrogen leaching."*

Another couple echoed similar sentiments by explaining how they want to house cows indoors to be able to milk three times a day and to be able to spread effluent only when the conditions for it are right. In closing remarks, they wrote:

> *"This 'Clean Green Image' is not factually based, it is just about seeing cows outside on grass in ideal weather conditions, the fact is there are as many day[s] of bad weather that cows are outside unsheltered in either cold and wet or when it is hot with no shade. The fact is the more time cows spend off pasture and have their effluent collected and spread when conditions are ideal the lower the nutrient losses are. We should still have cows on pasture, we just need facilities for cows to be off pasture when conditions are not nice for the cow and the environment. If we all had that, our nutrient losses from the dairy industry will be very minimal."*

These quotes highlight that there is no one perfect system, and that ideas of what an environmentally sustainable system looks like varies from individual to individual. As many participants noted in the interviews, dairy farming is very diverse, and people can choose the system that they believe suits their situation and goals best. Operating high input systems does not necessarily mean that farmers are less environmentally friendly than those operating low input systems, nor that these farmers care less about the environment. Biospheric values regarding environmental concern may be present in both cases and have a key part in the decision on which production system or practices to choose and why.

6.3 Perceptions of the dairy industry

Perceptions of the dairy industry were found to be intimately connected to the participants' choice of farming system in the qualitative phase of the research. It was thus important to capture respondents' beliefs and concerns about the current state of the dairy industry in Aotearoa New Zealand and its future to further examine threat appraisal. Respondents were asked to rank 40 statements inspired by the most prominent discussion points during the interviews. For each statement, respondents could indicate their level of concern using a five-point, Likert-type response format (Not at all, A little, A moderate amount, A lot, A great deal). Respondents were also able to add up to three extra areas of concern that were important to them. This section compares the data collected from this question, from all respondents and compared across different groups.

Figure 24 presents an overview of the most concerning aspects for all respondents. The greatest concerns centred largely around two themes: Media and public perception (Uneducated urban population on farming matters, Unbalanced media reporting, Public perception of dairy farming), and Regulation and governance (The cost of compliance, Too much red tape making dairy farming difficult, Government not supporting dairy, Good farm land being converted into housing). Additionally, respondents were quite concerned over 'Mental health among dairy farmers due to stress', 'Profitability of dairy farming in general', and 'Preserving the dairy pathway'[14]. Only 'Uneducated urban population' and 'Unbalanced media reporting' concerned farmers a lot (mean score and error bars above 4, meaning that these aspects concerned all respondents 'A lot' to 'A great deal'). The three aspects that on average concerned respondents less than a moderate amount were 'Lack of independent advice from consultants and advisors', 'The impact of dairy farming on the climate', and 'Not enough competition among dairy companies'. All other 32 aspects concerned them moderately to a lot on average.

Of 16 concerns that were added by 20 respondents, bad leadership in politics and the dairy industry was mentioned four times. Lack of understanding of farming matters and misdirected research was also mentioned four times. Two respondents mentioned specifically that releasing GMOs (genetically modified organisms) was a concern. That farmers are the target of activism and sabotage was mentioned twice. Talent being lost from the industry and it becoming increasingly difficult to buy your own farm was also mentioned by four respondents. Finally, a conventional farmer explained how he is greatly concerned that authorities are "making new environment laws

[14] 'Preserving the dairy pathway' refers to the ability of young farmers to progress through the dairy industry over time from farm worker, to manager, to sharemilker, to finally attain the goal of owning their own farm.

without fully understanding the impact and challenges they will bring before making sure all farmers are compliant to existing rules and regulations". This supports sentiments heard during the interviews that regulation can be impractical and lead to unfair and unintended consequences if authorities adopt a 'one-size-fits-all' approach. Smaller farms with less capital may, for example, be worse affected than a larger farm by an introduced legislation that requires investment in infrastructure.

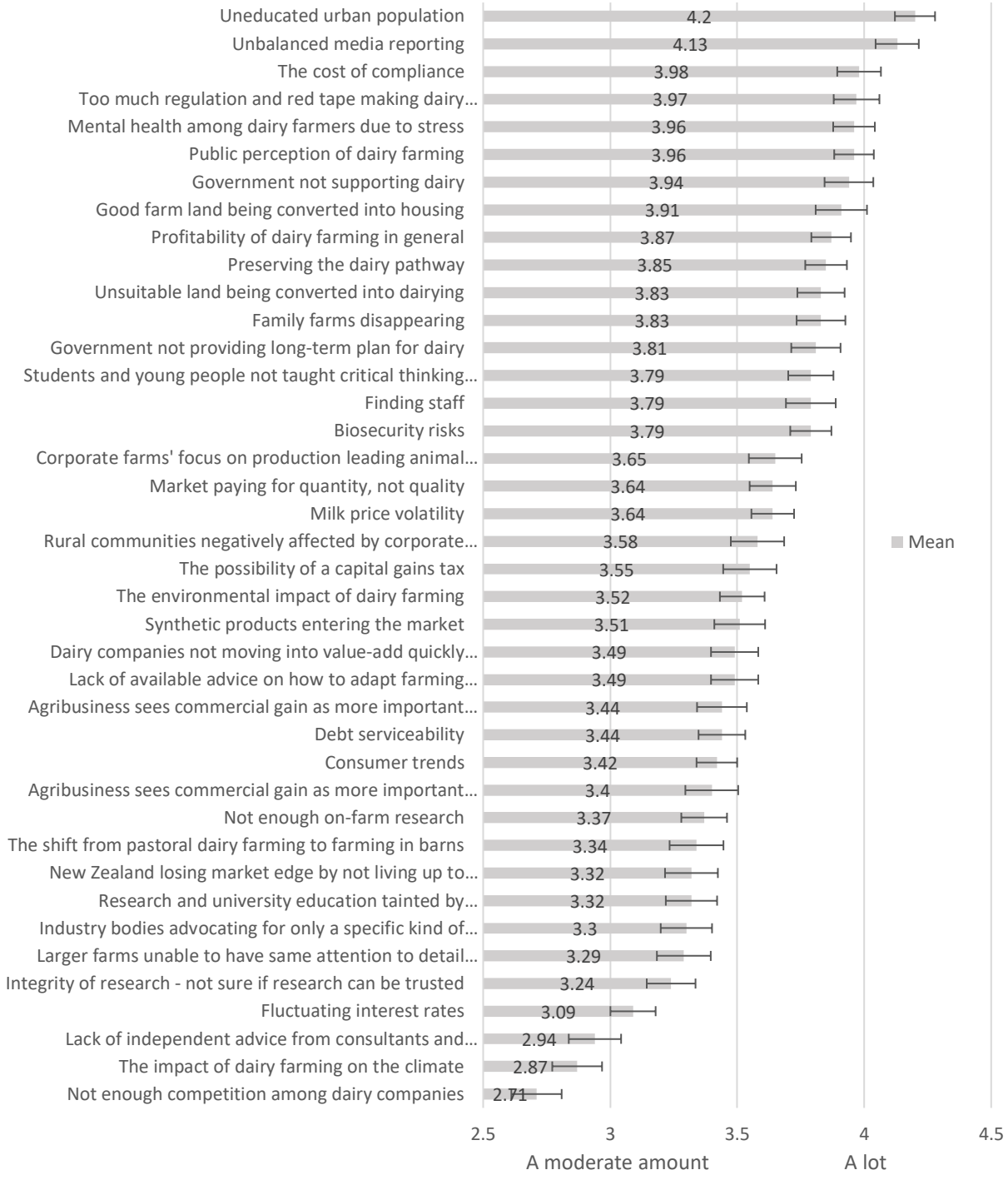

Figure 24. Graph showing all aspects ranked according to how concerned respondents were about the dairy industry and its future. (See Table 15 for the full text of each perception.)

To tease out differences in threat appraisal and motivations, the three groups (conventional, biological and organic) were based on the respondents´ choice of future system (if they indicated that they would not change their system, they retained their choice of current system as their future system). This was deemed appropriate as their future choice indicates the direction in which they are going and ought to be aligned with the perceptions and reasons behind their choice. It

was appropriate to assemble the 40 perceptions into themes in order to emphasise variation in perceptions and attempt to bring out patterns in the dataset. Initially, each perception was examined for factorability and found to correlate 0.3 with at least one other perception suggesting reasonable levels of factorability. The Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy was 0.858, which is above the recommended value of 0.6, the communalities were above 0.4, and Bartlett's Test of Sphericity was significant (χ^2 (780) = 3576.631, $p < 0.001$). It was therefore deemed appropriate to use principal component analysis. The first two factors explained 29% and 10% of the variance respectively. The next two factors explained 6% of the variance each, and the next four factors each explained 4%, 3%, 3% and 3% of the variance. Looking at the scree plot, the eigenvalues level off initially after the fifth factor but finally after the eighth factor. Two variables load heavily on the seventh factor (the impact of dairy farming on the environment and the climate), however, which indicates an eight-factor solution (see the rotated component matrix in Table 15 and the scree plot in Figure 25).

	Component							
	1	2	3	4	5	6	7	8
Public perception of dairy farming						0.798		
Unbalanced media reporting		0.452				0.676		
Uneducated urban population		0.291				0.815		
Consumer trends	0.270			0.458		0.338	0.221	
Biosecurity risks				0.541		0.323	0.331	
Finding staff				0.554		0.331		
Preserving the dairy pathway		0.267		0.447		0.510		
Milk price volatility		0.296		0.657	0.321			
Fluctuating interest rates			0.229	0.807				
Debt serviceability				0.766				
Family farms disappearing	0.267		0.676			0.219		
Larger farms unable to have same attention to detail as smaller farms	0.301	0.303	0.662					
Corporate farms' focus on production leading animal welfare and environmental concern to come second			0.810		0.216			
Rural communities negatively affected by corporate farms	0.220		0.745					
Unsuitable land being converted into dairying			0.494					0.448
Good farm land being converted into housing	0.426		0.312			0.229		0.420
Integrity of research - not sure if research can be trusted	0.699							
Not enough on-farm research	0.734							

	Component							
	1	2	3	4	5	6	7	8
Lack of independent advice from consultants and advisors	0.657			0.246				0.233
Industry bodies advocating for only a specific kind of dairy system	0.657							
Students and young people not taught critical thinking and creativity	0.679			0.215				
Agribusiness sees commercial gain as more important than improving farms' profitability	0.727				0.314			
Agribusiness sees commercial gain as more important than protecting animal, human and planetary health	0.656		0.242		0.343		0.263	
Profitability of dairy farming in general	0.332	0.346		0.354			0.396	
The possibility of a capital gains tax	0.203	0.513		0.237	0.291	0.218		
Too much regulation and red tape making dairy farming difficult		0.827						
The cost of compliance		0.803						
Government not providing long-term plan for dairy		0.756		0.206		0.243		
Government not supporting dairy		0.708						
Lack of available advice on how to adapt farming systems under incoming regulations	0.272	0.525	0.281	0.224			0.228	
The environmental impact of dairy farming							0.866	
The impact of dairy farming on the climate				0.201			0.809	0.207
The shift from pastoral dairy farming to farming in barns					0.320			0.682
Synthetic products entering the market				0.265	0.680			0.293
Market paying for quantity, not quality	0.244		0.358		0.653			
New Zealand losing market edge by not living up to 'clean and green' reputation	0.217		0.308		0.638			
Dairy companies not moving into value-add quickly enough	0.289				0.681		0.209	
Not enough competition among dairy companies			0.319		0.483		0.282	
Mental health among dairy farmers due to stress		0.225	0.501		0.271			

Table 15. Rotated component matrix for principal component analysis showing eight groups.

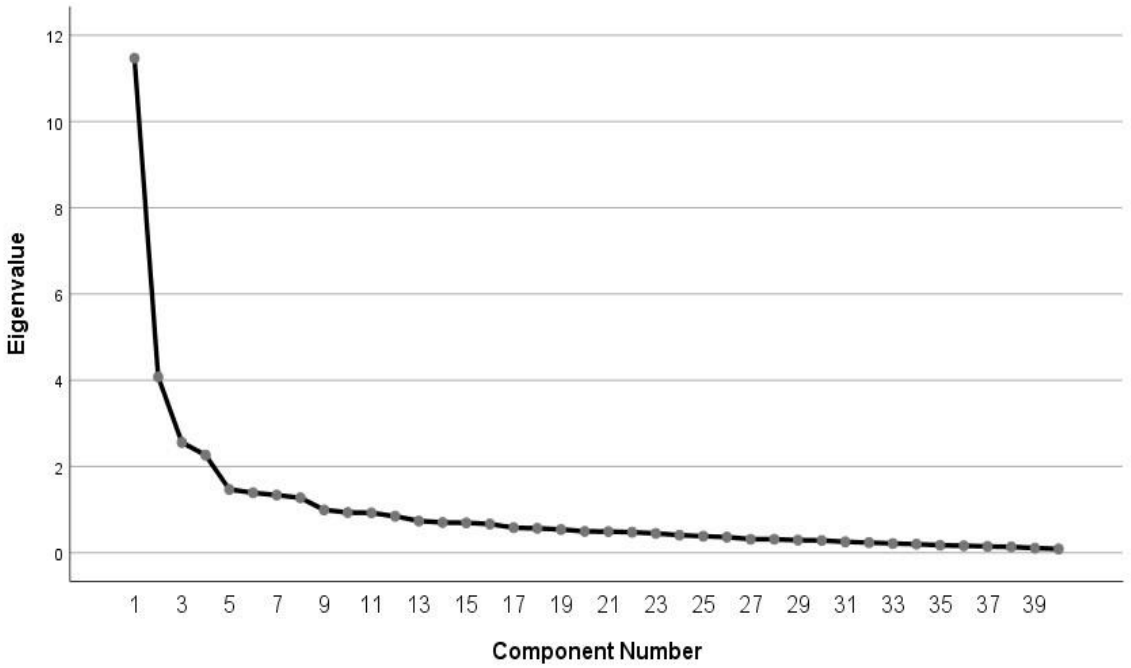

Figure 25. Scree plot of principal components analysis of perceptions.

The eight groups (Table 16) were named Commercial interests and advice (component 1), Government and regulation (component 2), Corporate farming (component 3), Business risks (component 4), Market influence (component 5), Impact of media (component 6), Impact of dairy farming (component 7), and Land use change (component 8). ´Profitability of dairy farming in general´ was placed in its own group as it was very difficult to place thus creating nine groups; Principal component analysis (rotation converged in 11 iterations) gave it an almost equal association with Commercial interests and advice (0.332), Government and regulation (0.346), Business risks (0.354), and Impact of dairy farming (0.396). ´The shift from pastoral dairy farming to farming in barns´ was only strongly associated with one group, Land use change, in the principal component factor analysis. ´Unsuitable land being converted into dairying´ and ´Good farm land being converted into housing´ were difficult to place as they were associated with several groups. The former was associated equally between Corporate farming (0.494) and Land use change (0.448). The latter was associated mostly with Commercial interests and advice (0.426) and Land use change (0.420), and to a lesser degree with Corporate farming and even less with Impact of media. Due to their similar nature, these three perceptions were subjectively placed together in the group Land use change.

Aspects of concern	Group
• Research and university education tainted by agribusiness commercial interests • Agribusiness sees commercial gain as more important than improving farms' profitability • Agribusiness sees commercial gain as more important than protecting animal, human and planetary health • Students and young people not taught critical thinking and creativity • Integrity of research - not sure if research can be trusted • Not enough on-farm research • Lack of independent advice from consultants and advisors • Industry bodies advocating for only a specific kind of dairy system	Commercial interests and advice
• The possibility of a capital gains tax • Too much regulation and red tape making dairy farming difficult • The cost of compliance • Government not providing long-term plan for dairy • Government not supporting dairy • Lack of available advice on how to adapt farming systems under incoming regulations	Government and regulation
• Family farms disappearing • Larger farms unable to have same attention to detail as smaller farms • Corporate farms' focus on production leading animal welfare and environmental concern to come second • Rural communities negatively affected by corporate farms • Mental health among dairy farmers due to stress	Corporate farming
• Finding staff • Consumer trends • Biosecurity risks • Milk price volatility • Debt serviceability • Fluctuating interest rates	Business risks
• Synthetic products entering the market • Market paying for quantity, not quality • New Zealand losing market edge by not living up to 'clean and green' reputation • Dairy companies not moving into value-add quickly enough • Not enough competition among dairy companies	Market influence
• Unbalanced media reporting • Uneducated urban population on farming matters • Public perception of dairy farming • Preserving the dairy pathway	Impact of media
• The environmental impact of dairy farming • The impact of dairy farming on the climate	Impact of dairy farming

Aspects of concern	Group
• The shift from pastoral dairy farming to farming in barns • Unsuitable land being converted into dairying • Good farm land being converted into housing	Land use change
• Profitability of dairy farming in general	Profitability

Table 16. Thirty-seven perceptions organised into nine groups based on similar themes.

To be able to analyse the differences between these groups and production system, a series of Kruskal-Wallis tests were conducted on the mean value of the rankings within each group for each participant. The adjusted p-value when looking at these nine groups was 0.006 (0.05/9=0.00555). Market influence (χ^2 (2, n = 172) = 18.194, $p < 0.001$), Commercial interests and advice (χ^2 (2, n = 172) = 16.299, $p < 0.001$), and Corporate farming (χ^2 (2, n = 172) = 10.904, $p = 0.004$) were found to significantly differ between future production systems (Table 17).

For all three perception groups, future conventional respondents were significantly less concerned than future organic producers (Market influence: adjusted $p < 0.001$; Commercial interests and advice: adjusted $p = 0.001$; Corporate farming: adjusted $p = 0.036$) as well as significantly different from future biological producers (Market influence: adjusted $p = 0.013$; Commercial interests and advice: adjusted $p = 0.044$; Corporate farming: adjusted $p = 0.021$). The results indicate that, in general, the perceptions within these groups are only moderately concerning to conventional respondents whereas they concern agroecological respondents a lot.

Perception groups	All future production systems	Mean rank	*p*-value	n	Effect size
Market influence	Conventional Biological Organic	73.72 99.33 114.92	< 0.001*	172	10.6%
Commercial interests and advice	Conventional Biological Organic	74.75 96.68 115.38	< 0.001*	172	9.5%
Corporate farming	Conventional Biological Organic	76.17 100.38 103.56	0.004*	172	6.4%

*Table 17. Three perception groups differ significantly between future production systems. * = significant at the adjusted p-level 0.006.*

To examine which factors in each of the Market influence, Commercial interests and advice, and Corporate farming groups contributed to the significance among future production systems, a Kruskal-Wallis test was conducted for each perception. The adjusted *p*-value when looking at all 40 aspects individually was 0.001 (0.05/40=0.00125). 'Family farms disappearing' was the only

aspect belonging to the Corporate farming group that showed a significant difference between groups (χ^2 (2, n = 172) = 15.240, p < 0.001) and explained 9% of the variation when taking this conservative approach (Table 18). Pairwise comparisons show that the significant difference is that organic producers are on average a great deal more concerned about this than conventional respondents (p = 0.001). It is interesting to note that loss of family farms was on average ranked most concerning by organic respondents, whereas it came in 4th place among biological respondents (a lot concerned) and in 17th place among conventional respondents (moderately to a lot concerned).

Three significant aspects belonged in the Commercial interests and advice group: 'Industry bodies only advocating for a specific kind of system' (χ^2 (2, n = 169) = 13.029, p < 0.001), 'Agribusiness sees commercial gain as more important than improving farms' profitability' (χ^2 (2, n = 170) = 17.408, p < 0.001), and 'Agribusiness sees commercial gain as more important than protecting animal, human and planetary health' (χ^2 (2, n = 169) = 24.847, p < 0.001). These aspects explained 8%, 10%, and 15% of the variation shown respectively.

Perceptions	Future production system	Mean rank	Median	*p*-value	n	Effect size
New Zealand losing market edge by not living up to 'clean and green' reputation	Conventional Biological Organic	70.80 99.36 121.62	3 4 5	< 0.001*	170	16.1%
Agribusiness sees commercial gain as more important than protecting animal, human and planetary health	Conventional Biological Organic	71.55 94.50 122.10	3 4 5	< 0.001*	169	14.8%
Agribusiness sees commercial gain as more important than improving farms' profitability	Conventional Biological Organic	74.56 92.33 117.66	3 4 5	< 0.001*	170	10.3%
Family farms disappearing	Conventional Biological Organic	76.98 93.94 114.77	4 4 5	< 0.001*	172	8.9%
Industry bodies only advocating for a specific kind of system	Conventional Biological Organic	75.32 91.58 112.14	3 4 4	0.001*	169	7.8%

*Table 18. Five aspects of perception differ significantly between future production systems. * = significant at the adjusted p-level 0.001.*

Pairwise comparison for the first two aspects showed significant differences between organic and conventional ($p = 0.002$ and $p < 0.001$ respectively) indicating that future organic respondents were a lot to a great deal concerned whereas conventional respondents were only moderately concerned. These were ranked on average in 15th and 4th place respectively by organic respondents, and 34th and 29th by conventional respondents. There was no significant difference between biological and organic or between biological and conventional for these two aspects.

There were significant differences between both organic and conventional ($p < 0.001$) as well as between biological and conventional respondents ($p = 0.023$) for the third aspect, 'Agribusiness sees commercial gain as more important than protecting animal, human and planetary health'. Organic producers were a lot to a great deal concerned (ranked 2nd), biological producers were moderately to a lot concerned (ranked 26th), and conventional producers were moderately concerned (ranked 35th).

A similar effect was seen in the aspect 'New Zealand losing market edge by not living up to 'clean and green' reputation' in the Market influence group (χ^2 (2, n = 170) = 27.281, $p < 0.001$). This aspect had the largest effect size of 16% and showed that organic and biological respondents were a lot to a great deal concerned ($p < 0.001$ and $p = 0.003$ respectively) in comparison to conventional respondents who were on average moderately concerned.

Thus, it would appear as if there are three distinct groups among our respondents who see the world rather differently. The differences in perception among the three production system groups show in general that conventional farmers are less concerned about issues relating to damaging commercial interests of agribusiness to profitability and planetary health, corporate take-over, and New Zealand not being as clean and green as the marketing image portrays, in comparison to biological and organic farmers. It also shows that organic farmers are, in general, more concerned about these aspects than biological farmers. It is important to note here again that these results pertain only to the 173 respondents who took part in this study and not the wider dairy farming population in Aotearoa New Zealand. The results do, however, allow us to gain an insight into these particular respondents' beliefs and concerns which might have influenced their appraisal of threat and stress on their farming system and by extension the choice of farming system that they are maintaining or would ideally like to adopt.

6.4 Comparisons with demographic data

Including personal and farm-related questions offered an opportunity to use Mann-Whitney U and Kruskal-Wallis tests to see whether there were any differences in responses between groups that could be explained by these factors. Apart from production system, the questionnaire collected

data on gender, family situation, level of education, location, position on farm, and dairy farming background. Data analysis found that none of these factors had a significant influence on the reasons behind choice of current or future production system. Gender, position on farm, family situation, background in dairy, as well as location in the country did not show any significant differences between perception groups nor across the individual perception statements at the adjusted *p*-levels either. This shows that including farmers who are not only owner-operators (as was the case in the qualitative phase) in the web questionnaire was permissible.

Kruskal-Wallis tests were also performed to see whether perception groups differed depending on type of education. Out of 173 respondents, only two had selected Primary school as their highest qualification, and only nine had selected 'other'. To build up the power of the test due to the small number in these two groups compared to secondary school (n = 37), trades qualification (n = 50), and university (n = 74), they were excluded from the analysis. The only perception group that was significantly different at the adjusted *p*-level between groups was Corporate farming (χ^2 (2, n = 160) = 12.333, p = 0.002). The effect size is 7.7%. Pairwise comparisons show that university graduates are significantly less concerned than both secondary school leavers (p = 0.004) and those with trades qualifications (p = 0.036). Secondary school leavers were a lot to a great deal concerned whereas university graduates were moderately to a lot concerned. Those with trades qualifications were on average a lot concerned about aspects of corporate farming.

Looking at which specific aspects might concern different groups differently, it became clear that university graduates were significantly (χ^2 (2, n = 158) = 21.624, p < 0.001) less concerned than the other two groups about 'Larger farms being unable to have same attention to detail as smaller farms'.

6.5 Attaining or maintaining choice of system

Coping appraisal was tested along with facilitating conditions through the final three open-ended questions, which were designed to understand what support (if any) dairy farmers require to adopt or maintain their choice of practices or production system successfully. Respondents were asked to give suggestions as to how their current or future farming system could be made easier to manage or make possible to reach, and how they would improve the dairy industry if they could choose freely. Respondents could thus explain if there were any particular barriers that, once removed, would allow them or give them the confidence to implement their desired changes.

The answers to each question were examined by looking at the responses of each of the three groups – conventional, biological and organic. The three groups were based on the respondents´

choice of future system (if they indicated that they would not change their system, they retained their choice of current system as their future system).

6.5.1 Current system improvements

The respondents who had selected that they did not have a future farming system toward which they strive, were asked the question 'What would make your current system easier to manage?'. Thirty-seven conventional, three biological and seven organic respondents (64% of 74 possible respondents) answered this question.

Issues with finding and retaining good staff was a top consistent concern among respondents (nine conventional and five organic).

> *"Better trained staff, higher quality hands on experience as opposed to sitting in lectures and arriving on farm totally detached from the real farming world." (conventional farmer)*

> *"Getting the right staff (intelligence, capability and good attitude) and retaining them." (organic farmer)*

Some also suggested that the government should make it easier to employ immigrant labour to help staff shortages (two conventional). To help with finding, retaining and paying staff as well as provide the owners with some much needed rest, some respondents suggested that the dairy company should fix the milk price or at least make it more consistent or higher (seven conventional).

> *"A second full time person. Pay out needs to go up to enable me to pay someone the new minimum wage....." (conventional farmer)*

> *"Achieving a more consistent payout so we could afford staff or even a weekend off. We are so tired, and work 24/7." (conventional farmer)*

Another farmer said that contract rates need to be improved as the current rate gave the respondent a wage lower than minimum wage and less than what the staff earned. Being able to earn more money in order to spend more time with family or take a day off were also related proposals. Two respondents said that decreasing stress on staff and themselves form part of the reason why they are considering changing practices to a once-a-day milking system in the future, which is consistent with participant I2's reasons explained in Chapter 5.

> *"Changing to all once a day next season for better health and cow condition, less empty cows, less stress on staff." (conventional farmer)*

"Maybe another person [staff] would give me better work-life balance but can't justify cost. Maybe full OAD in future instead." (conventional farmer)

The other large issue for respondents from all groups was compliance (11 respondents). Many questioned the efficiency of regulations achieving the outcomes they are intended to achieve, or the respondents were questioning the authoritarian approach of government and regional councils (two conventional, one biological).

"…we do not require the authoritarian approach. There should be a process for us to be free of the compliance humbugs when we are farming pure and green". (conventional farmer)

"Less compliance. We know what we are doing and do it well. We care about our land and our stock greatly and don't need others checking up or telling us what to do". (biological farmer)

Some farmers thus expressed a need for greater autonomy in a system where they could be trusted with doing good things for the land and the environment without having to be told or forced. Not being acknowledged for their actions were frustrating to both respondents taking part in the web questionnaire, as well as participants taking part in the interviews. The time spent on compliance, double audits and data collection without knowing what good it would do was also frustrating to a few respondents. Some also mentioned that dairy companies were going over the top as well.

"…Less paperwork would make our lives easier especially as the purpose to which some of it is put appears to be unknown - data collecting for collection sake without anything appearing to be done with it or in some cases it not showing to make any difference to outcomes." (conventional farmer)

"…Less paper work in the form of micro managing by dairy companies. We have not got certified organic as there is no premium to be had in our area and therefore the paperwork involved is not worth it. However, Fonterra is moving more into making farmers record every detail of their operation even down to filling in details of monthly plant cleanliness checks etc. when this (for example) should be evident in the milk quality which is thoroughly checked. When I was in management, we were encouraged to look at outcomes of staff instead of micromanaging them down to the last detail and it feels like Fonterra is moving into the latter with some of their requirements." (organic farmer)

Many respondents outlined different environmental measures that they were doing on their farms and how they aim to take care of and improve their land for future generations. The frustration of

having to 'prove' that they are environmentally sound through compliance was frustrating to many. One conventional farmer also said that changing regulations and the difference in compliance between local bodies made it more difficult for them to purchase their first farm as changing compliance presents a financial risk.

Aside from the three main suggested improvements (finding good staff, making the payout more consistent, and less compliance), new infrastructure on farm, such as new technology in the cowshed, was mentioned by three conventional and one biological respondent. If overcome, these facilitating conditions could enable these respondents to manage their current system better. Other suggestions included ways in which to improve the wellbeing of farmers such as ending name-calling of farmers, creating a better work-life balance, and improving conditions for passionate people to enter and stay in the industry.

6.5.2 Future system improvements

The respondents who indicated that they have a future system towards which they strive were asked 'What would help you reach your ideal future farming system?'. Out of 99 possible respondents, 64 (65%; 28 conventional, 25 biological and 11 organic) answered this question. The top suggestions from the conventional group were similar to the major points addressed in the previous section. Higher quality staff (four conventional) was followed by a wish for minimised milk price volatility (three conventional, five biological), ease of repayment of debts (three conventional, three biological, one organic), and less costly regulations and health & safety (three conventional, one biological, one organic). Two conventional and one biological respondents also advocated for a clearer long-term plan from the government as well as more information and assistance on how to meet new compliance targets. These ideas are identical to those voiced by many participants in the interviews as well.

> *"A clear plan from government as to how dairying will continue and to set the rules that are achievable and set in place for a period of time and not changed with each change of government." (conventional farmer)*

> *"Regulators giving education to farmers before the new regulations come into act and discussions about compliance before they choose to enforce [them]. Farmers try to act quickly in response to broken systems, but we don't have people doing just one job. We are constantly multitasking which means sometimes it takes a few hours to find something broken before we can fix it." (conventional farmer)*

"Some direction from [government] as to what they want. Farmers can adapt but not instantly. Many farmers want to do the best for sustainable farming." (conventional farmer)

A longer-term plan from government and information prior to new regulation coming in would enable farmers to change their practices at a pace that works for their specific situation and for their context according to these respondents. As long as there is a clear vision and a deadline by which new practices need to be adopted, farmers are able to adapt to them with a lot less frustration.

There were also calls for more information dissemination from industry bodies as well as from research institutions (six conventional, one biological). Confidence that there is enough research available was low among some conventional respondents who wished for clear advice based on trustworthy science.

"Honest information vs the feel good e.g. biological vs organic vs synthetic inputs and the actual impact vs the feel-good story." (conventional farmer)

"I fully agree that farming should be a sustainable practice. I do not think that the science we have at the moment is robust enough to determine how much environmental impact current dairy farming practice is having on the waterways as there are huge complications on what the human environmental foot print is…It is often perceived that bought in food is bad for the environment. Do we have robust science to quantify that this is true[?]. It adds to a young top soil and reduces the use of 'artificial' fertilisers. I think there is a balance that can be found and remain profit[able]." (conventional farmer)

"More conversations about system profitability. DairyNZ showing that reducing cost of production increases profitability…Show the linkage between good environmental and climate change practices and profitability - promote the good systems." (conventional farmer)

Aside from minimising milk price volatility, the biological respondents' top suggestion was incentivising production of sustainable products (one conventional, five biological, one organic), followed by lower interest rates (one conventional, four biological, one organic), and promotion and support for biological and regenerative farming systems (three biological, one organic). Some of the suggestions for improving uptake of biological methods included more research, taxing synthetic nitrogen use and introducing premiums.

"Government, Federated [Farmers], DairyNZ and the rest understand regenerative agriculture and starting to heal our land, and us, as farmers doing this, getting paid for building carbon in our soils." (biological farmer)

"An awareness and acknowledgment from my current processing and marketing provider (Fonterra), about the value and need to market a unique and differentiated milk product, based on nutritional difference of milk derived from cows only fed on grazed pasture." (conventional farmer)

"Making grass-fed farms receive a premium for not using supplements such as pke. Pay for milk quality not quantity." (organic farmer)

"…A premium for free range, grass-fed, locally produced, environmentally respectful milk." (biological farmer)

The organic respondents did not have any obvious top suggestions as they were only a small group of eleven respondents answering this question. One respondent mentioned similar sentiments to those above saying that processing companies should take *"a longer-term view to supply contracts of higher value products. This would provide more certainty for producers to pursue and invest in improvements to their systems".* Although biological and uncertified organic respondents currently cannot access any premiums for the products they produce, some feel that premiums for their products or taxes on certain conventional practices would support the transition to agroecological production systems. Financial security through premiums or longer contracts with dairy companies are important elements of farm businesses for these respondents. High costs of compliance also concern organic respondents who asked for more support from government and industry.

"It is very important that regulations are not all lumped together for the different farming types as the management processes of the different farming practices…locality, soil type and pasture species create totally different environmental outcomes, and you stop farmers being creative because of very inflexible and high cost resource management rules." (organic farmer)

"Government and industry help rather than adding costs e.g. compliance making dairy farming only break even at best." (organic farmer)

There was also two respondents who called for independent advice on practices and farming systems by others than sales representatives from companies that have products to sell.

"It is so stressful showcasing our [organic] farming methods to the conventional arena that is flooded with industrial propaganda." (organic farmer)

"Independent advice in the systems I would like to pursue, most advisers have a product they sell." (organic farmer)

The suggestions and concerns of the respondents resonate with those made by participants in the interviews. Many agroecological respondents appear to feel little support from government and industry bodies. They suggest different measures that would help promote the adoption of systems they are interested in and promote practices that they see as more sustainable (e.g. grass-fed, no PKE) while punishing the use of practices that they see as unsustainable (e.g. synthetic nitrogen).

A clearer plan from government, access to information regarding the advantages and disadvantages of different practices and production systems, a different payment system based on quality and output were listed as strong suggestions on how respondents felt they would be better able to reach their ideal farming system. Planning for the future effectively requires information on what is expected of farmers so that they may gauge what, if anything, needs to change in their system and by how much. This is in essence an evaluation of the severity of potential threats and how vulnerable the farm business might be to it. The need for more information on different options, on the other hand, is more a tool for evaluating the alternative ways of coping that respondents might adopt in response to the threat. Finally, developing a new system of payment based on quality might act as a facilitating condition that makes it financially viable to follow through on an intention to supply grass-fed or biologically produced milk for instance. The question of how to enable the ideal future farming system to become reality has thus given an opportunity for respondents to show many facets of their decision-making process (threat and coping appraisal as well as facilitating conditions) whereas the responses to the question of how to improve the management of respondents' current system were almost solely centred around removing barriers.

6.5.3 Dairy industry improvements

All respondents were able to answer the last question 'How would you improve the industry and dairy farmers' situation?'. Out of 173 respondents, 104 (60%; 61 conventional, 25 biological, and 18 organic) answered this question. This question was asked to capture any additional ideas that respondents might have on improving the industry in general, rather than just their own farming system.

The top suggestion and concern by far for all three groups was to improve public perception and educate the public about how food is produced (18 conventional, 7 biological, 3 organic). There

was a general feeling that the perceived negative current climate is detrimental to the respondents' wellbeing and for the relationship between town and country.

> *"Need to somehow educate the general public that not all farmers are just out to destroy the environment and abuse animals. Unfortunately these stories sell papers and the reality of what actually happens on farms and the good work done to help the environment are not being told. We need a government that is actually going to help farmers do this rather than knocking farmers at every opportunity." (conventional farmer)*
>
> *"Stop making dairy farmers feel like the devil himself." (conventional farmer)*
>
> *"There needs to be a massive marketing campaign around dairy farming and products. Most farmers care passionately about the land and their stock but that is never portrayed in the media, it's only the negative comments and stories that hit the news." (conventional farmer)*
>
> *"Educate the NZ public about the dairy industry and how hard all farmers work to produce the best products they can." (biological farmer)*

The top suggestions of improving public perception, setting a more consistent milk price and increasing the ability to find and retain good staff were also explained in Section 6.5.1. Aside from these three main topics, two conventional and two biological respondents wished that high input farming should be actively discouraged in favour of more grass-based and profitable systems that have a lower impact on the environment.

> *"Smoking is taxed because it ruins peoples' health and costs the country billions, alcohol is taxed for the same reasons... so why the hell isn't artificial nitrogen. The more we use the more harm we do. Get rid of it…completely. DairyNZ conducted research a few years ago (dairy push) that proved that no dairy farming system was more profitable than another... from system 1 to 5...Profit was to do with good management not system. So, get rid of the polluting, soil destroying [nitrogen] and return to system 1 or 2, take the pressure off staff and land and concentrate on profit not production. The science is out there, it just can't get past big business and their PR budgets." (biological farmer)*
>
> *"Bring them back to grass and profitable systems. Intensification of feeding systems has led to increased workloads without any extra profit." (conventional farmer)*
>
> *"Get farmers focusing more on profit (not production) while improving environmental footprint. Encourage groups such as Dairy Environment Leaders as role models. More*

education about systems and managing pasture to maximise profit." (conventional farmer)

A conventional couple who wished to operate a system of milking three times a day by housing cows partly indoors, explained how they think people (presumably decision-makers) should be more open-minded and see that their system can help reach environmental and animal welfare targets as well. They see that it is important to include all kinds of profitable systems so that the public is not misled.

"It is dangerous and self-defeating to be anti-cow housing and anti-large farm when at the same time wanting to find ways to reduce dairy's environmental impact. Furthermore, public perception of dairy needs to be a top priority for our industry, if we are bickering internally in the industry about how to farm there is no way the public will trust that we are trustworthy, we can farm many different ways and end up with the same results of profitable businesses that look after the animals the people and the planet." (conventional farmers)

Five conventional and one biological farmer wanted Fonterra to become a true cooperative again by either suggesting changes to DIRA or giving back more to shareholders. There were voices from each group (two conventional, two biological, three organic) who mentioned more or clearer research on the impact of different types of farming on the climate and environment, which was partly covered in the previous section.

"Increased research to solve environmental (incl climate change) issues…More research into applied research re benefits of automation and precision agriculture." (conventional farmer)

"…More valid and reliable research on how farming is damaging the environment and more specifically how." (biological farmer)

"DairyNZ needs to investigate and promote alternate systems to the conventional, rye/clover, Ravensdown/Ballance. The industry needs to be researching diverse pastures to combat environmental challenges, not GM that consumers around the world are resisting, get away from silver bullets and study how nature works." (organic farmer)

"Get the correct believable science around climate change, carbon, recycling, pollution, population, and environment protection." (organic farmer)

"…sprays etc. are giving health issues, fertilisers are giving health issues. There should be balance and more research and education [on] what certain things influences health." (organic farmer)

There was an evident request for knowledge to make decision-making more sound around which practices and production systems would give the most benefits in terms of profitability, environmental impact as well as socially for work-life balance. With increased knowledge, respondents may feel more equipped to evaluate and respond to changes in society and industry.

A few respondents took time to answer with more specific suggestions directed at the government to financially assist smaller farms in meeting the high compliance costs, conduct research on the environmental effects of best practice, and involve farmers more in consultation about regulations rather than relying on computer models.

"Government and councils set up a programme similar to what has been recently done to help family farms improve their systems and technology. This involves council and government providing half the cost up to as high as $500 000 for farm improvements such as to meet compliance. My latest research found that these compliance costs are causing small scale family farmers to only break even each year. This one off assistance from the industry and councils/government will improve the profitability and environmental sustainability of NZ farms and improve rural communities' trade and social equity through upgrading smaller family farms." (organic farmer)

"Environmentally speaking, I think as an industry we're well off the mark. Industry best practice isn't promoted enough, nor is there any accountability if it's not achieved. My challenge to the industry and government is: If best practice was followed with current limits (i.e. no change to farm inputs or cow numbers), what would the difference in environmental change be, in terms of N leached etc.? There are so many things which are easily achievable on every farm to work towards a better environmental footprint for dairy. Rather than seek huge gains from say a stocking rate limit or N limit, lots of little efficiencies over many areas may be able to give the same gain." (conventional farmer)

"Easier access to regulations. I find meetings are held, but periodically, and those holding the meetings often can't answer questions due to lack of knowledge. Better research and consultation around setting out regulations rather than all being set on theory or models. Cost of regulation is very high, money could often be better spent elsewhere (consents for consents sake don't keep rivers clean or gorse sprayed)." (conventional farmer)

There is a clear will among these respondents that they would welcome more active involvement with the design of regulation to make sure that they are just, cost effective and scientifically supported to deliver the results they are intended to.

The high costs of farming and low profitability are not only seen as barriers to employing more staff or meeting compliance targets. One conventional contract milker explained that they were seriously looking at leaving the dairy sector as they were really worried about where it is going in the near future. The main reasons for considering this were finding staff and increasing costs of electricity, petrol, staff wages (permanent and relief staff) and contract rates not being high enough *"to really get anywhere"*. That farmers are selling wholesale to dairy companies but buying retail in services was mentioned by participants I and K2 as well. This puts additional financial pressure on dairy farmers, which may act as a barrier to complying with regulation, trialling new practices, or even, as in this case, continuing a career in dairy farming.

There are a multitude of further suggestions and ideas from the respondents on how to improve the dairy industry. These are, however, outside the scope of this thesis and will be covered in a different publication in the future. This question has shown that the respondents are seeking further knowledge in a range of fields to be able to make sound decisions on which practices or production system to employ in order to either reach regulatory targets or their own individual goals. An evaluation of the response efficacy of different options is clearly vital, which will have an impact of the level of self-efficacy and control they feel in trying to achieve their goals. Wellbeing of farmers through being fairly treated by media and understood by authorities and the urban population was clearly important to the vast majority of respondents. Although some conventional respondents were quite happy to punish those in the industry who use "bad" practices, most explained how farmers in general take good care of the land and their animals but that this story was seldom told.

6.6 Summary

The majority of the analysis in this chapter has revolved around the differences between conventional, biological and organic respondents as regards their choice of farming system. Indeed, analysis shows that production system accounted for the largest effect in comparison to any of the other demographic data collected such as position of farm, location, and background in dairy farming. Of the conventional farmers who responded to the survey, 24% expressed an interest in adopting an agroecological production system in the future. Of these, the vast majority were interested in a biological or regenerative system rather than an organic one.

The survey showed that low environmental impact, consumer demands, and improved public perception were strong reasons for respondents either maintaining their current agroecological system or wishing to adopt an agroecological system in the future. This indicates that these aspects form part of the motivation for current and prospective agroecological respondents when choosing their system, which addresses the second objective of this study. Although all respondents ranked feeling good operating their particular system very highly, agroecological respondents felt this significantly stronger than conventional respondents.

In contrast to the responses on the reasons behind their current system, it was interesting to note that there was no significant difference between those who in the future wished to be conventional and those who wish to be biological for the aspects low environmental impact, consumer demands, and improved public perception. It shows that those respondents who in the future wish to tweak their conventional systems are doing so for similar reasons as respondents who wish to adopt or maintain a biological system in the future. The drive to be more environmentally and socially sustainable appears to be similar for these groups suggesting that respondents are collectively moving along the spectrum towards what they believe are more sustainable practices albeit with different practices in mind. The quantitative data thus supports the qualitative data from Table 6 in Chapter 5 outlining the diversity of choices considered and the similar benefits perceived.

Although biological and organic respondents show similarities, there are differences in the strength of their opinions. Organic farmers are in general more concerned than biological farmers on issues relating to damaging commercial interests of agribusiness to profitability and planetary health, corporate take-over, and New Zealand not being as clean and green as the marketing image portrays. Conventional farmers are, in general, less concerned about these aspects than both the other groups. It could indicate that those who are more concerned about these aspects may be more inclined to complete a greater system redesign and move to an organic production system than those who are less concerned. It is clear that beliefs surrounding larger shifts in society (e.g. consumer trends and environmental regulation), and how they might influence the respondents' perception of how resilient their farm system is in relation to those changes, are important factors when deciding on future practices or production system. The ability to appraise threats to one's current farm system and evaluate ways in which to cope with them, appear to be central elements of decision-making as expected. The quantitative analysis thus supports the findings from the qualitative data.

As interesting as it is to look at significant differences between groups, it is equally interesting to see where their concerns and beliefs about the dairy industry and its future align. For example,

although not significantly different, both biological and conventional respondents ranked 'uneducated urban population' and 'unbalanced media reporting' as their top two most concerning aspects, whereas organic respondents ranked this in 9th and 23rd place respectively. This was also the most mentioned topic among respondents when asked what would help improve the dairy industry moving forward.

Conventional and biological respondents on average felt that governmental support for dairy farming and costs of compliance concerned them a lot. Organic respondents agreed with them regarding costs of compliance, which is not surprising considering that certified organic producers need to be audited regularly as well as adhere to standard environmental regulation. Interview participants described this as an expensive process which often involves a lot of paperwork. Lack of governmental support for dairy farming, however, was ranked by organic respondents in 33rd place (moderately to a lot concerning). Despite the big difference in rank, the three groups are not significantly different indicating that all respondents feel a similar level of concern regarding these two matters, which again was evident in the open-ended questions. It also highlights that other aspects, such as family farms disappearing, are more concerning for organic respondents.

Similarly, organic respondents were on average more than a lot concerned about the environmental impact of dairy farming (ranked in 8th place of most concerning aspects), whereas biological and conventional respondents were only moderately to a lot concerned. However, no statistically significant difference could be found among groups suggesting that environmental impact of dairy farming concerns them all, but that they have different ways of mitigating the perceived impacts. As was shown in the open-ended questions, many respondents were frustrated that their efforts at improving the land and minimising environmental impact on their farms largely go unnoticed, and that only bad news are reported by the media.

The three open-ended questions at the end of the questionnaire provided an insight into the kind of improvements that future conventional, biological, and organic respondents would like to see in their industry going forward and how they could be supported in achieving their individual goals. These suggestions will form part of the recommendations for policy-makers outlined in Section 8.2. It is clear that many aspects are considered to be major problems or barriers to farming the way that respondents would ideally like to. The difficulty in finding staff, a volatile or low milk price, and the changing nature and high costs of compliance were also recurring themes for all groups. This was further evident from the data analysis, which showed no significant differences among groups in concern for these and other aspects, such as synthetic products entering the market place, biosecurity risks, consumer trends and mental health.

There was a recurring theme around the need for research institutions and authorities to focus their efforts on investigating and promoting the profitability of systems rather than productivity. Some respondents (as well as interviewee participants) opted for low cost and low input systems as they felt these systems are both more profitable and have a lower environmental impact. Other respondents outlined how their high input system with a herd home and proper effluent management can be equally profitable and good for the environment and animal welfare. Based on these accounts and as one respondent eloquently reflected, it thus seems reasonable to propose that management and not production system per se are the determining factors for running a profitable, environmentally sound and socially acceptable operation. Many participants in the interviews also outlined how there is no 'good' or 'bad' system, it is how they are managed. There were calls for clearer research aimed at understanding the true financial and environmental effects of operating different systems. There were also calls, especially among agroecological respondents, for sustainable systems to be acknowledged and promoted by industry bodies and government through either punishment of "bad" behaviour or rewards for "good" behaviour.

7 Discussion

In this chapter, the contribution to the sum of knowledge and theoretical implications of the findings from this study will be discussed. First, a summary of the main findings from the two phases of the research will be presented, ending with a discussion on the use of production system labels for groups of farmers in this type of research. Second, the conceptual framework presented in Chapter 3, which served as a base for the methodological approach, will be discussed alongside the findings of the study looking at the central processes of decision-making, influential factors, and factors that moderate behaviour. A final model of dairy farmer decision-making in response to stress is also presented here. Third, an evaluation of the results will be presented. Finally, the implications of the overall findings will be discussed in relation to the wider societal and industry changes that dairy farmers are facing.

7.1 Summary of findings

The qualitative data showed us that there is a wide array of choices that participants may consider when deciding on which practices or production system to operate. The choice largely depends on beliefs around what the perceived benefits of the practice or production system are, what suits their farm and context, and whether they think they will be able to implement any changes they might wish to make. The degree of change seems to align with the degree of perceived severity of threat and how vulnerable their operation is perceived to be to those threats. Similarly, those who perceive an opportunity to change practices or production system that would yield great benefits in comparison to their current system, seem more likely to change than those who perceive few benefits. Participants that deem their farm businesses to be resilient to societal and industry challenges seem less likely to redesign their production system and, instead, may strive to maintain or improve their current system by tweaking their current practices. Those who perceive high levels of threat (or opportunity) to their farming system now, or believe they will in the future, seem more likely to redesign their system or substitute parts of it. Perception of stress on the farm system and the perception that there is a relative advantage (response efficacy) and ability to change (self-efficacy and perceived behavioural control), seem to be central processes of threat and coping appraisal. These findings lend support to the conceptual framework outlined in Chapter 3, Figure 11.

A number of factors were found to exert a moderating effect on threat and coping appraisal in the qualitative phase: external knowledge, social connectedness, observational learning, prior experience, personal characteristics, affect, values, beliefs and attitudes, and subjective norms. Some participants experienced that significant events acted as triggers that elicited the evaluation of the whole system thus acting on the influential factors. Actual social norms and facilitating

conditions seemed more to act as enablers and barriers to behaviour rather than as a major influence on the decision processes. As such, they were classed as factors moderating behaviour. All these factors thus had an important part to play in the decision-making process of the participants in this study. Habits were not found to have an influence on any part of the process other than being related to prior experience in terms of practices that the farmer commonly uses, and are excluded from the final model of decision-making. Autonomy is a value that was found to be important for most participants; they preferred the ability to choose practices or production systems that enabled them to retain autonomy. Rather than being forced to change by authorities or industry bodies, these participants wish to change their practices or production system because they perceive a relative advantage of doing so.

Of all the qualitative factors that were found to be important to decision-making, beliefs about threat and coping appeared to be the strongest. The web questionnaire was built around these main processes to determine whether the findings from the interviews would be supported or rejected by using a larger number of informants. Perceived severity of threats and response efficacy were directly tested by asking questions about the respondents' perceptions of the dairy industry and the perceived relative advantage of their current and future system, which were found to be related to choice of practices and production system.

Although there were no statistical differences between most perceptions of the dairy industry among the three groups (conventional, biological and organic), the strength of their opinions differed significantly in three areas. Organic respondents were in general more concerned than biological respondents on issues relating to damaging commercial interests of agribusiness to profitability and planetary health, corporate take-over, and New Zealand not being as clean and green as the marketing image portrays. Conventional respondents were, in general, less concerned about these aspects than both the other groups. All groups were similarly concerned about issues such as the negative public perception of dairy farming and media reporting, cost of compliance, and environmental impacts, indicating that these stresses affect all respondents to some degree. How it affects them and what option they choose to counter the threat (maintain current system, improve efficiencies, substitute practice, or production system redesign) is highly individual, however.

Low environmental impact, consumer demands, and improved public perception were strong reasons affecting the perceived relative advantage of respondents either maintaining their current agroecological system or wishing to adopt an agroecological system in the future. Those who wished to stay conventional shared these reasons for their overall choice of farming system too,

but to a lesser extent. This indicates that these perceived benefits were considered a relative advantage for changes to variations of their chosen production system, such as diversifying income streams or supplying a value-add product. There was thus support for the diversity of choices outlined in Chapter 5 (Table 6) where different practices elicited similar perceived benefits.

There was a sentiment among many respondents and participants that production systems or practices cannot necessarily be divided into good or bad. Instead, it is the management thereof that is important, which led to calls for more research on profitable and sustainable management systems to be conducted. Respondents of all three groups exhibited similar levels of concern for most perceptions on the dairy industry and similar reasons behind choice of system. This shows that the farming system is so much more than just the production system label that they have been assigned. Other variations to the production system, such as diversifying income streams, changing milking frequency, and changing intensity of the farming system, also have an influence on perceived relative advantage, which could be equally important. These types of changes may be considered for the same reasons that a change in production system might be considered. The spectrum of participants presented in Chapter 5 (Figure 13) therefore comes to mind. That spectrum was constructed to outline how difficult it can be to define a distinct group of farmers. It also raises the question as to how useful these labels actually are.

The challenge of labelling farmers as belonging to either a conventional, biological or organic group has become even more apparent through the course of this study. It was useful for investigating whether motivations for choosing a certain practice or system were different between groups (second objective). These labels were generally found to explain more of the variance in perceptions on the dairy industry and relative advantage among production system groups than other personal and farm-specific factors. They were also useful for the discussions on affect, values, norms, and significant events in the qualitative phase of the study. Beyond that, the labels had little value in the analysis of the data in this study. The practices that are involved in a conventional system, such as milking frequency, value-add options, or income diversification, can be as widely different as those within an organic system, and there may well be a lot of overlap in practices between two systems with different labels. This highlights the complexity of dairy farming decision-making and the value of conducting a study such as this that takes a more holistic view on decision-making, which has incorporated a number of potential influences. It also highlights the risks of conducting reductionist studies on decision-making, as important connections and associations may otherwise be overlooked or conflated with other variables.

7.2 Major processes of decision-making

The decision-making process itself was found to be the same for all participants; a specific blend of influential factors act on threat and coping appraisal, which creates an intention to act, which, in turn, is influenced by other factors that moderate behaviour. A decision to change will be initiated if the threat is perceived to be significant, if the benefits of change are perceived as exceeding the costs (perceived relative advantage), and if the farmer feels confident that they can implement the changes (perceived self-efficacy). A threat appraisal leads into a coping appraisal. As described in Chapter 5 and outlined in Table 6, there are a multitude of different choices a farmer might consider for their business. The perceived benefits and outcomes of different practices and production systems are often similar showing that farmers have similar motivations for maintaining their choice of system or the intention to change their system. Although these motivations for decision-making are similar, the extent to which different factors have an influence will be different from individual to individual. For example, for some, social connectedness might have a big part to play, whereas for others, adherence to strong personal values might be the main driver. This thesis did not set out to give weightings to which factors are the most important in general, and I strongly assert that this is appropriate. This study clearly outlines how the motivations and drivers behind high-cost decision-making, such as changing practices or production system, can be very different depending on the individual context and other influential factors. Even after an intention has been created, individual facilitating conditions may either enable, or hinder, the intention to translate into behaviour.

The final model of decision-making (Figure 26) is presented below and will be explained in the next sections and its differences to the conceptual framework in Chapter 3 outlined. First, the main processes involved in decision-making (stress and coping appraisal) are discussed. Second, the influential factors that act on them are outlined. Finally, the factors that moderate behaviour are presented, followed by a discussion on the socio-physical context in which decision-making takes place.

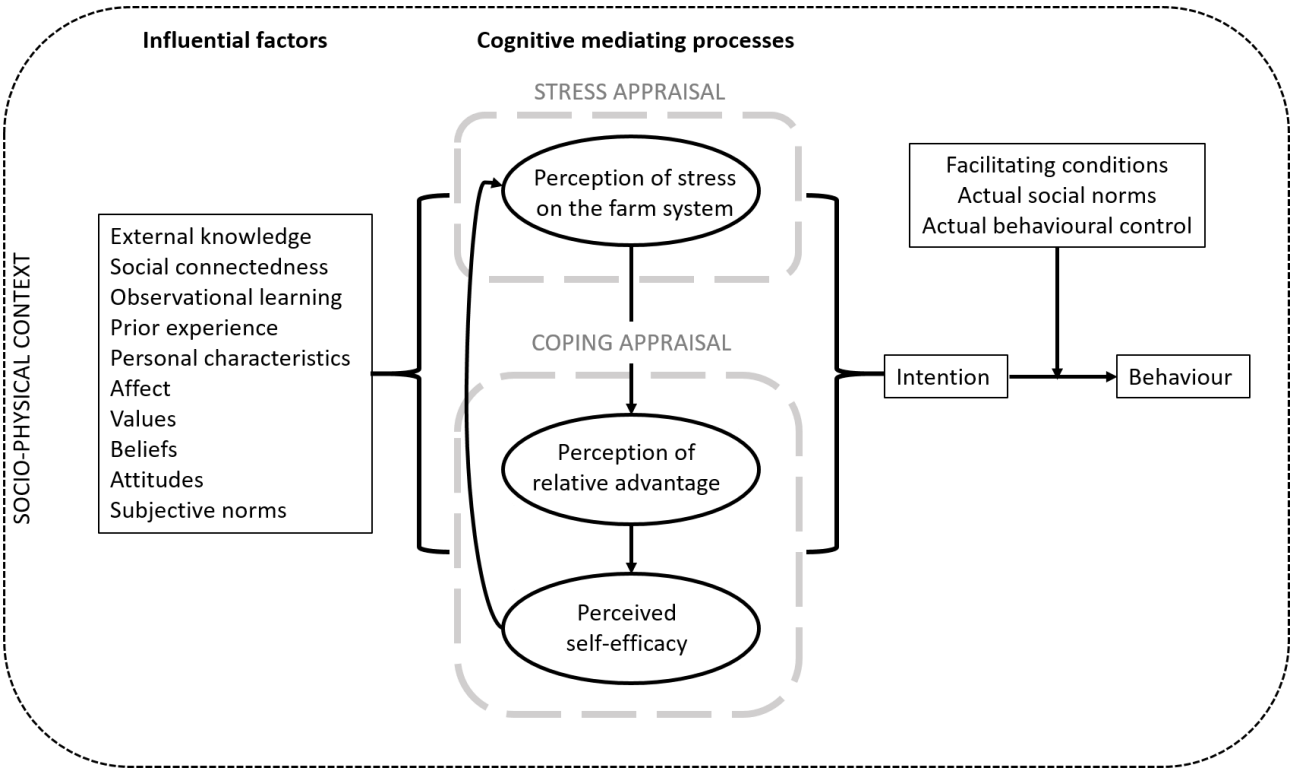

Figure 26. A proposed integrated model of dairy farmer decision-making.

7.2.1 Stress appraisal

The conceptual framework for this study (Figure 11) suggested that the PMT's threat appraisal would be one of the main cognitive mediating processes influencing how dairy farmers decide whether or not to change practices or production system. In this context, threat appraisal was described as an evaluation of the rewards of continuing the current course of action, the severity of the threat and how vulnerable the farming system is to it. This study has shown that there is support for threat appraisal's inclusion as this seems to be the first step in the decision-making process dairy farmers go through prior to evaluating the options for change. This is also supported by Floyd et al. (2000) and the fact that 'awareness of consequences' (AC) is a precursor to 'ascription of responsibility' (AR) in the VBN.

In the final model presented in this study (Figure 26), the perception of threat has been broadened to perception of stress on the farm system. Although similar, 'perception of stress' allows for the possibility that stress can be positive, contrary to the inherently negative connotation of 'threat'. Richard Lazarus (1999) explains that there are three types of stress involved in the Cognitive Theory of Stress and Coping that he proposed together with Susan Folkman: harm/loss, threat, and challenge. Harm/loss has already happened, whereas threat is harm/loss that has not yet happened but is possible or likely in the near future (Lazarus, 1999). Situations can be experienced as stressful when an individual perceives little control over the situation. The same situation can, however, also be seen as a challenge if there is a high level of control (Folkman, 2013). This is likely related to self-

efficacy, which will be discussed in the next section on coping appraisal. It is clear from the interviews and the questionnaire that participants and respondents are experiencing stress on different levels. One example is the negative public perception of dairy farming where many expressed a range of emotions from anger to sadness, from understanding to disbelief. Respondents in the survey ranked this as their top concern in the dairy industry and something they wished would be addressed. Some see a positive public perception as something that has already been lost or that dairy farmers are at the threat of (unjustly) losing. Others expressed similar sentiments, but decided to change practices or production system to address it at farm level. Improving public perception was an important reason for respondents and participants adopting organic or biological practices for instance. This type of response seems to change the feeling of threat or harm/loss to that of challenge, since farmers feel able to address the problem. This gives support to the renaming of the term to 'stress appraisal' in the final model to include opportunities as well as threats in the individuals' appraisal. Aside from this, the function of stress appraisal is the same as for the original threat appraisal; an evaluation of the severity and vulnerability of the threating event occurs, which is related to the rewards of maintaining the current system.

7.2.2 Coping appraisal

Similar to the PMT, it is recognised in this study that perceived response efficacy and self-efficacy are two separate constructs. Response efficacy and the anticipated response costs have, however, been merged as one process named 'perception of relative advantage' in the final model (Figure 26). This recognises that perception of relative advantage has been identified as a driver for adoption by several other scholars (e.g. Pannell et al., 2006; Small et al., 2015) and that the response costs are an inherent part of the appraisal of whether a new practice or production system will outweigh the current practice or production system. Perception of relative advantage came out very strongly in the interviews as the perceived benefits that an alternative system has compared to the current system. This process often guides the farmer in evaluating which practice or production system he or she thinks is most suitable to adopt.

Once an evaluation has been made over what option would be the best to implement on farm, the next step is assessing the capability to implement those changes. This step is akin to 'implementation' described by Ohlmer et al. (1998), where the resources or skills needed for the change are assessed and acquired. If the capability to make a particular preferred change is absent, the farmer may evaluate other options or courses of strategy. In the case where no suitable solution can be found, farmers may become frustrated and stressed (Ohlmer et al., 1998).

Self-efficacy is kept as part of coping appraisal as defined in the original structure of the PMT, but with slight moderation. As described above, if an individual experiences a high level of control in a situation, a stressful event can be seen as a challenge rather than as a threat. An individual who feels challenged by the problem is in a better position to do something about it and gain mastery over the situation through perseverance and self-confidence (Folkman, 2013; Lazarus, 1999). As such, perception of stress on the farm system can be moderated by perceived self-efficacy, which is why there is an arrow from the latter going to the former in the final model. This is a moderation of the conceptual framework and indeed of the original PMT. Although self-efficacy was not tested directly in the survey, the interviews showed that confidence is built by observational learning, such as demonstration by other farmers, and trialling practices yourself, which builds experience, as well as through external knowledge and social connectedness. These influential factors will be discussed in later sections.

Perceived behavioural control, which is a cornerstone of the TPB, was included in coping appraisal in the conceptual framework (Figure 11) as it bears resemblance to self-efficacy in that both concepts relate to level of control over behaviour. It was also included due to its potential as a moderating factor of behaviour similar to facilitating conditions. Although most scholars agree that perceived behavioural control and perceived self-efficacy can be empirically distinguished, scholars disagreed on whether internal or external drivers reflected the two constructs differently (see Section 3.2.2. for a discussion). The data presented in this study suggests that it would be best to differentiate between the internal and external drivers. Hall, Turner, and Kilpatrick (2019) follow Ajzen (1991) and differentiate between perceived behavioural control (perceived capability to perform the behaviour) and actual control (external factors influencing ability to perform the behaviour) in their study on the uptake of pasture management tools by Tasmanian dairy farmers. Differentiating the concept in this way would allow for actual control (external, non-motivational factors, e.g. money and cooperation of others) to have a direct influence on behaviour (as depicted in the original TPB model in Figure 9), whereas perceived behavioural control, related to internal motivation, influence the intention to act. For this reason, actual behavioural control has been grouped with facilitating conditions and actual social norms (to be discussed in Sections 7.3.7 and 7.4) as a moderating factor to behaviour, and perceived behavioural control is considered akin to perceived self-efficacy. For this reason, 'perceived self-efficacy' is the construct that remains in the final model.

7.3 Influential factors

In the conceptual framework presented at the end of Chapter 3 (Figure 11), influential factors (originally termed environmental and intrapersonal sources of information in the PMT) were

expanded to include specific factors found to be of importance to farmer decision-making through a literature review. Affect, values, beliefs, attitudes, norms (from the VBN, TPB and TIB), and social connectedness were added. These factors along with personal characteristics, prior experience, external knowledge and observational learning, were found to have an impact on dairy farmers' decision-making when it comes to deciding which practices or production system to operate (Cowan, Wright, Kaine, & Cooksey, 2015; Ohlmer et al., 1998; Pannell et al., 2006). All these factors are interrelated and influence how an individual appraises and responds to different forms of stress. It was also found that these operate at different strengths and influence the three processes (perception of stress, perception of relative advantage, and perceived self-efficacy) to different degrees depending on the situation at hand and the socio-physical context. As such, the strength of the perception of stress, perception of relative advantage, and perceived self-efficacy depends on these influential factors and the interactions between them.

7.3.1 External knowledge, observational learning and prior experience

Prior experience, external knowledge (e.g. education) and observational learning from the conceptual framework were identified as important influential factors to include in a model of decision-making. They were shown to have an impact on beliefs and, by extension, on all three processes (perception of stress on the system, relative advantage and self-efficacy). Trust in information sources is, however, crucial for evaluating information (Cowan et al., 2015; Hu et al., 2006; Pannell et al., 2006; Small et al., 2015) indicating that the messenger is often more important than the message itself. This further highlights the influence that these factors have on a decision that could ostensibly be seen as rational. Trust in social networks, external information sources, and the government has an influence on individuals' evaluations of options. This trust affects how strongly farmers perceive a relative advantage when changing practices and how certain they are that they are able to execute the change successfully. Hence, non-rational factors moderate the decision-processes in the final model. For example, the stigma that agroecological practices (especially organic) carry, concern about social acceptance, and the uncertainty regarding whether they are profitable systems in the long-term, could be barriers to the adoption of such systems. Indeed, Pannell et al. (2006) suggests that effort should be placed on increasing the credibility, legitimacy, and reliability of conservation practices to increase the rate and speed of adoption of such practices.

External knowledge and observational learning were often cited, by the participants in the qualitative phase of the study, as instrumental to gaining the confidence to try new things and gain experience. This result was also found by Pannell et al. (2006). Once enough external information has been gathered and irrelevant options eliminated, Pannell et al. (2006) suggest that personally

trialling the practice on a part of the farm is the next step. As has been reported by participants taking part in this research, as well as found in the literature (e.g. Small et al., 2015), farmers trust the words and actions of other farmers more than those of organisations that represent primary industry and government.

Le Heron et al. (2016) found something similar in their reflection on dairy farmers' transition to biological systems. They described it as a journey of three parts: initial experience of biological farming, progress and gaining experience by doing, and being able to think about farming in new ways. They state that it involves a remaking of identity, relationships at home and with business partners, and with the soil, which could also have follow-on effects on the relationships within a catchment. Similar sentiments were also expressed by Hill (1998) who stated that the mindset shift was of a deeper nature when redesigning production systems. The transition is not only about changing the management on the farm and the learning of new ways but also involves greater implications that have an impact on intra- and interpersonal factors and relationships. This was also found in the qualitative phase of the study where some participants, who had adopted agroecological production systems, found that their neighbours were interested in what they were doing rather than critical. This experience also led to increased levels of wellbeing.

The link between knowledge and capability is imperative and there is a constant exchange between the two as we continue to learn throughout our lives. Acquiring more knowledge on how to adopt a new practice or production system, after perceiving a relative advantage to do so, may lead to a new perception of stress on the system. It might change the perception from one of threat to one of opportunity as the individual increases their perceived self-efficacy through learning and experience.

Prior experience was an important factor for all participants, and many conventional farmers in particular mentioned operating a system similar to the one in which they were brought up. Similarly, Kalaugher et al. (2016) suggest that experienced farmers have adaptive strategies for dealing with risks associated with climate change and extreme weather. These strategies include not stretching the system to its limits (buffering), ensuring the farm system is diverse and flexible enough to cope with variability, careful planning and building social capital. As this example suggests, increased age and experience can influence the adaptive capacity of an individual and make him or her feel more resilient in the face of external threats. The level of risk one might accept before acting might thus change with time and experience. Indeed, participant J2 mentioned that his way of dealing with an impending drought was quite different to that of younger farmers who were panicking over having little grass in the paddocks. The younger farmers wanted to start

feeding silage to the cows, whereas the participant let the animals graze the little they had left in the paddocks in order to be able to feed out silage throughout the winter. His age and experience in farming had the effect that he was able to stay calm and recall similar situations and respond in a different way than the younger farmers. Prior experience, external knowledge and observational learning are therefore important elements that, in accordance with the expectations of the conceptual framework from Chapter 3, are included as influential factors to the main processes of decision-making.

7.3.2 Social connectedness

Social connectedness was included in the conceptual framework to account for how networks and relationships between people can affect decision-making. Some of the participants were active in different networks and groups such as Federated Farmers, DairyNZ or local research groups. These groups were important in order to share information and experiences, bounce ideas and get the latest news on the pressures facing the industry. Here, participants were able to filter information by discussing regulations, public perception and changing consumer trends with their peers and industry authorities. These interactions and exchanges had a considerable influence on participants' perception of stress as well as relative advantage. The input from, and discussion with, trusted people in farmers' social networks placed them in a better position to make choices for their business in response to the potential threats posed to the industry, such as reduced antibiotics use, introduction of synthetic proteins, and incoming taxes on greenhouse gas emissions. In this way, social connectedness could validate or enhance the perception of risks to the farm business's resilience and persistence, which could lead to an increased level of stress. It could also give them a view of hope sharing different points of view on the opportunities facing the industry. Hence, social connectedness is an influential factor that acts on the perception of stress (threat or challenge) on the system, which can be an antecedent for motivation to be created in order for practices on farm to change. This is supported by Pannell and colleagues (2006) who state that social connectedness is important as an enabler.

7.3.3 Personal characteristics

Personality variables are an integral part of intrapersonal sources of information in the PMT (Rogers, 1983) and were kept in the conceptual framework under the heading 'influential factors' because aspects of one's personality such as openness to change and neuroticism, most likely have an influence on the perception of and response to threat to one's farm business (Pannell et al., 2006). There is not strong evidence from the interviews that participants regard personality variables as a major variable, as many do not seem to spontaneously report them. However, the participants'

overall characteristics became apparent during the interviews through discussions on issues such as level of risk aversion.

Ohlmer et al. (1998) used an example of the deregulation of the Swedish agricultural market in the 1990's where two farmers faced the same problem, but reacted to it at different times. They stated that, depending on personality, the farmer could detect problems either early or late in the process. In this way, one farmer perceived a greater threat and responded early, whereas the problem slowly grew in the mind of the other farmer until it reached a level where the problem became significant enough to do something about. Appraisal of a specific situation depends on the circumstances and how they might affect the individual. In this way, personality has an important part to play in appraisal and in what emotions are evoked during stressful situations (Smith & Lazarus, 1990). In the face of changing circumstances for farmers in terms of increasing regulations or changing consumer demands, it might be important for farmers to feel hope that they can cope with the situation. Personal characteristics are thus connected to self-efficacy and whether or not a situation is experienced as harm/loss, threat or a challenge.

The level of openness to new experiences and level of extraversion that a person has can combine and enable the person to extend their social network and improve social connectedness leading them to new avenues of thought and beliefs. Some people, however, are not naturally inclined to be extroverted or open to new experiences but force themselves to be social and extroverted, thereby going against their inherent personality. For example, participant B2 became involved in Federated Farmers, not because he felt he was naturally inclined to but because of the benefits he saw in being part of that group. Stepping out of his comfort zone was the price to pay to allow for the realisation of other personal goals, which in his case centred on becoming exposed to potential employers. An individual's overall characteristics can be overcome by sheer will if other goals are considered important enough. Personal characteristics are therefore an essential influential factor to be considered with an acknowledgment of their interaction with other factors. Further study would be needed to discern, in detail, which personality traits are the most prominent when deciding whether or not to adopt different practices or production systems.

7.3.4 Affect

Affect, a factor included in the conceptual framework from the TIB, explained how the participants feel about public perception, operating a specific production system (most often organic) or the best thing about being a dairy farmer. All participants were passionate about dairy farming and about how their chosen system suits them. Based on the data collected in this study, affect is likely to be an outcome of operating a specific production system rather than a major variable that

explains decision-making in the context of this research. There were no clear indications in the interviews that affect had influenced either the perception of stress on the farming system or perceived self-efficacy. There were some indications that affect could have an influence on perception of relative advantage as it could be a reason to maintain a chosen system once adopted because doing so makes the practitioner feel good. Thus, affect could make the rewards of keeping a current practice greater than the benefits of an alternative practice. It was, however, a difficult factor to discern from the interview material and was not tested in the survey, which suggests that further study in this area would be beneficial. Based on its importance found in literature review and the indications found in this study, however, affect is cautiously kept in the final model as part of influential factors similar to the conceptual framework.

7.3.5 Values

Values and goals were also found to be important elements of the decision-making process (as also found by Ohlmer et al., 1998). This suggests the inclusion of moral elements to the final model. When dairy farmers in New Zealand were asked which factors influence their decision-making, work satisfaction was rated higher than profit-making (Fairweather, 2010). This suggests that quality of life is central to dairy farmers, which makes sense as the workplace is an integral part of the home and family life for most dairy farmers (Keating & Little, 1991; Mortlock & Hunt, 2008; Nuthall, 2010). This was also found in this study; a lifestyle with a manageable amount of stress seemed to be equally important for all participants. Feelings of stress and not having enough time for family also guided some participants away from certain practices. The pursuit of these values and goals led some participants in the direction of an agroecological system, a once-a-day milking system or a low-input, grass-based system.

Not only the farm manager but the whole family is usually involved in the running of the business, which Fulton and Vanclay (2011) state makes farming different from most other professions. That the business must make a profit is a clear objective, but it is equally important that other family and individual goals be taken into account. The stage of family development, therefore, has an impact on the short- and long term goals of the business (Nuthall, 2010). As the participants who had young dependent children explained (e.g. participants G, I2, and H), it can change the perspective on how they want to farm. A manager has to take into account considerations pertaining to the family when deciding whether or not to change practices or production system. This requires a great amount of consideration, consensus and mutual support due to the potential significant impact this kind of complex decision can have (McGowan, 2011; Pannell et al., 2006; Wallace, 2014).

Autonomy and motivation

Autonomy arose as an important value among participants in this study. A number of scholars (e.g. Benz & Frey, 2008; Markussen, Fibæk, Tarp, & Tuan, 2018; Stock & Forney, 2014) have similarly found that autonomy is an essential element of job satisfaction and subjective wellbeing among self-employed people like farmers. It was very evident in participants' love of their chosen vocation (i.e. being one's own boss and living on the land) but also frequently mentioned in relation to regulation and how farmers were not consulted enough in their design. Self-Determination Theory (SDT) proposes that the psychological needs for autonomy, competence and relatedness affect the strength and type of motivation an individual expresses (Deci & Ryan, 2008b). Autonomous motivation refers to both intrinsic and extrinsic motivation where an individual will voluntarily express a certain behaviour because they see a value in expressing it (Deci & Ryan, 2008b). Controlled motivation, on the other hand, is fuelled by external and introjected regulation. The former involves behaviour motivated by an external reward or punishment, and the latter may involve feelings such as shame or guilt being partially internalised if an individual would fail at expressing the behaviour (Deci & Ryan, 2008a, 2008b). By contrast, amotivation is defined as the lack of intention and motivation due to the individual not believing that the behaviour will lead to the desired outcome, or that they are unable to express the behaviour (Deci & Ryan, 2008b).

In this study, autonomous motivation seems to arise out of the perception of relative advantage and perceiving that the stress on the current system can be alleviated by changing practices or production system. As an example, a farmer would show autonomous motivation if they reduce the use of palm kernel voluntarily rather than due to the industry demanding it. Creating and maintaining autonomy seems to be a tool used by participants to adapt to different types of changes in order to reduce vulnerability. As Stock and Forney (2014) point out, however, autonomy is challenged by regulatory, industry and financial constraints. Despite these challenges, the prospect of maintaining autonomy may be a crucial element for farmers when deciding whether or not to adopt new sustainable practices on farm (Stock & Forney, 2014).

It cannot be conclusively stated based on the results of this study that autonomous motivation is always a result of the perception of relative advantage. Therefore, it is not included as a specific factor in the final model, although it is a part of influential factors as autonomy is inherently a value. It is hypothesized, however, that autonomous motivation is likely an outcome from the perception of challenge to the farm system (as opposed to perception of threat or harm/loss). It is deemed more likely from the interview material that farmers who have a more positive outlook on how the stress can be addressed feel autonomous motivation rather than controlled motivation, which may improve farmers' sense of wellbeing. In a stressful situation, an individual might feel anger, guilt,

anxiety, sadness, or hope, for instance. When feeling anger, it is common to blame others for what is happening whereas if you are feeling guilt, it is common to blame yourself. Those individuals feeling anxiety and sadness might have a low or uncertain coping potential in relation to the perceived threat, whereas those feeling hope might be able to cope very well (Smith & Lazarus, 1990). Anxiety caused by something outside an individual's control may, therefore, lead to low levels of coping. This highlights the importance of providing farmers with options and information on how threats might affect them in order for them to make sound decisions regarding their operation. Being provided with different options for coping might allow a farmer to realise a relative advantage in changing practices and experience autonomous motivation. This could induce a feeling of hope, enabling the farmer to cope well with the problem or situation at hand and feel challenged rather than threatened. Autonomous motivation and wellbeing in farming and their relation to coping success is therefore something that would be important to study in future investigations.

7.3.6 Beliefs and attitudes

Beliefs and attitudes are central modifiers to each of the three processes in the model. How farmers see the world around them influences whether they see a threat or opportunity to their business, how different options are perceived and evaluated against their current operation, and finally how they act. In light of this, the choice of practices or system is due to response efficacy (perception of relative advantage) tied to beliefs. Beliefs were found to be the strongest link between influential factors and stress and coping appraisal.

Pannell et al. (2006) and Ohlmer et al. (1998) argue that a farmer will adopt new practices if it enhances the achievement of their personal goals, which is related to their circumstances and preferences based on subjective perception rather than objective truth. How farmers perceive different options has a large influence on whether those options will be considered or not (Pannell et al., 2006). For example, a biological or an organic production system must first be perceived as a viable option by conventional farmers before they can consider adopting such a system. Similarly, beliefs and attitudes about different practices, such as eliminating synthetic fertilisers and organic alternatives to antibiotics use and how that might have an effect on the profitability of their system, influence which options are considered as feasible alternatives. By incorporating beliefs and other influential factors in the model, it is recognised that both rational and moral aspects are essential for understanding decision-making.

Beliefs around perception of stress and how vulnerable a farmer's operation is to threats is likely also tied to their thinking on how resilient their system is perceived to be to outer challenges. Many

respondents clearly felt that their choice of system is related to what they believe their consumers will desire in the future. Consumer trends towards more ethically and environmentally produced foods is only one aspect that can affect the business (volatile milk prices and environmental degradation are examples of other aspects mentioned by participants) but it is the aspect that was discussed the most. Adopting a system or certain practices that consumers are likely to increasingly demand, puts a farmer's business in a more future-proofed space enabling them to stay in business. This reasoning was echoed by agroecological participants in the interviews as well, stating that the next generation is thought to choose their products based on environmental and animal welfare standards (e.g. reduced nitrogen leaching, no bobby calves), nutrition (e.g. organic, A2), and social values (e.g. living wages for staff).

The specific inclusion of beliefs and attitudes (although partly inherent in the original PMT model) as suggested in the conceptual framework is therefore appropriate. Due to their significance in threat and coping appraisal, it can be debated whether they should not have a more prominent place in the final model. Being grouped with the other influential factors, however, highlights the interactions between the factors.

7.3.7 Subjective norms

Social, personal, and subjective norms were included in the conceptual framework to account for different influences. None of the participants explained directly how norms had helped shape their current or potential future practices. Discussions on social norms in the interviews primarily centred around the idea of "how dairy farming ought to be done" and how many agroecological participants found it challenging to go against common practice. These are examples of subjective norms, which may act as a barrier to considering certain options. None of the participants in this study appeared to have had this experience, however. The participants' belief in the relative advantage of their chosen option appears to have had a stronger influence than the effect of what they think other farmers would think of them.

There was some evidence from participants that social norms could have an influence moderating behaviour. Instead of hindering the creation of an intention with subjective norms, actual social norms could reinforce an intention, as in the case of the organic farmer who, unexpectedly, received positive feedback from his conventional peers. Although further studies would have to confirm these indications, the label 'norms' is split in subjective and actual social norms in this study, where the former is placed as an influential factor and the latter as a factor moderating behaviour. Personal norms were not noticeably evident from the interview material, and would be prudent to study in future research.

7.4 Factors moderating behaviour

As described in Sections 7.2.2. and 7.3.7. actual behavioural control and actual social norms were identified as moderators of behaviour. For this reason they have been grouped together with facilitating conditions in the final model. Habits were included in the conceptual framework as a factor influencing an intention translating into behaviour, as Rhodes, Casey, Payne and Brown (2016) argued that they are a key challenge for farmers in Aotearoa New Zealand when changing behaviour. This study did not find that habits had any direct influence on this type of complex decision-making. Changing practices or production system is not a behaviour expressed frequently, and so might be considered with greater care than other simpler decisions. Klöckner (2013) found that habits have a great impact on behaviour in studies on high-frequency behaviour, but changing practices or production system is likely to be a low-frequency behaviour. It is, therefore, understandable why the factor did not appear to be important in the interviews with the participants. This factor is not likely to be an integral part of a model on decision-making and has not been included in the final model.

7.4.1 Facilitating conditions

Facilitating conditions, as described by the TIB, was included in the conceptual framework as a factor influencing the intention to act. As outlined in this thesis, facilitating conditions, such as location and financial capacity, act as an external factor that enables the intention to transform into actual behaviour or, when absent, creates a barrier to this. Location was mostly mentioned in terms of the climatic conditions having an impact on farming practices or on land price, rather than a decision-making factor for a particular system. For farmers who produce organic, grass-fed, or A2 milk, having a dairy company located nearby who could pick up the milk was important but not always essential for a decision to be made regarding choice of production system. It seemed to be a more important factor for organic participants who had recently converted.

Financial capacity was important to all participants and especially for those who had debts or were otherwise constrained by an equity partnership or corporate structure. These participants were more constrained in their choices of production system because of the higher pressure to turn a profit, and this had an influence on whether they felt they could adopt certain practices.

The absence of facilitating conditions could also be termed constraining conditions, as these would constrain an individual from acting even though the intention to do so exists. Ohlmer et al. (1998) noted that a farmer might reconsider his or her choice if met with negative comments from their peers. This supports the inclusion of actual social norms at the end of the decision-making model as a potential barrier to behaviour. This notion was not found to be present among the participants

in this study *per se* but was mentioned as something they were prepared to face when converting to agroecological practices. Instead, it seemed that those who wished to convert primarily sought acceptance first among their close family, and information from close peers and consultants, before acting on their intention. Once the process was put into action, it was shared with other peers, and the course held steady.

7.5 Socio-physical context

The time and context in which a decision takes place has an influence on the perception of stress and how we subsequently decide to respond. The final model is, therefore, not time- or context-dependent, acknowledging that we are all living in a state of constant change one way or another. The perception of stress on the farm system is similar to problem detection as defined by Ohlmer et al. (1998), who suggest that expectation of the future in relation to unsatisfied goals was an important factor of decision-making. The participants and respondents answering questions on their future ideal system will be basing some of their reasons on events that are happening in this current time. In turn, this is based on their beliefs around those events, which can change over time due to new information or a change in context.

Time and context are tightly interwoven. As an example, there used to be very few environmental regulations in place restricting what dairy farmers could and could not do. Changing practices or production system was unlikely to be a result of regulation but of other contextual factors. Nowadays, dairy farmers are increasingly subject to environmental regulation, which will influence them differently depending on in which region their farm is located and what soil type they have. Those participants who had received relatively high nutrient leaching consents from their regional council were confident they could continue as before. Other participants, however, felt that they needed to adapt their systems to cope with remaining within the limits of their nutrient leaching consents, whereas others had to consider greater redesigns of their systems to cope. In twenty years' time, it is likely that something else will influence farmers' responses due to their individual context. As discussed in Section 5.3.7., the effect of time has an influence on the strength of the values an individual holds. As some participants explained, their priorities and goals had shifted in response to getting older and having children. This change brought these participants into considering different avenues that they previously may not have considered.

The context is affected by geopolitical, industry, and societal events that change over time. Geopolitical changes that affect dairy farming in New Zealand could be the signing of international trade deals, war or civil unrest, pandemics, and changes in the national government. These could have indirect and direct impacts on industry and society, which respond to these types of pressures

and signals. Such changes could include a change in milk price in response to international markets, or changes in best management practices related to the use of antibiotics or palm kernel extract. The industry also responds to changes in society such as public perception, regulation, and consumer demands. All these factors have a direct or indirect relationship to each other and have an impact on the farmer's perception of their farm system's vulnerability and how they decide to cope with it.

7.5.1 Significant events

Significant events can also be part of the socio-physical context. In farming, stress and its associated coping mechanisms could be induced by sudden significant events or through slower changes in society that have an impact on the business as described above. Sudden significant events was a factor that arose from the interview material that was not expected from the conceptual framework.

Primarily among agroecological participants, significant events appear to act as a trigger that gave the individual a chance to pause and take a second look at the system they were then operating. The strength of concerns and perceptions determines how much the aspects influence a farmer's decision-making. The significant events in the case of participant G, H and O might not have led them down a different path, had they not perceived problems with or threats to their previous system. They all perceived issues with their previous system but the specific opportunities that arose made them evaluate their current system more and consider alternatives. Based on this, significant events have an important function and can be viewed as a catalyst that result in a shift in mindset or context, or both. The definition of a significant event will, however, depend on the personality of the decision-maker (Eysenck, 1977; Smith & Lazarus, 1990) as well as on context (Bewsell & Kaine, 2005; Gatersleben, Murtagh, & Abrahamse, 2014) and the multiple goals of the decision-maker (Lindenberg & Steg, 2007; Nuthall, 2010). Significant events, therefore, becomes part of the socio-physical context.

7.6 Evaluation of results

Before discussing the theoretical implications of the results of this thesis, it is pertinent to first discuss its limitations to be able to evaluate the results. These limitations give an indication of where further study might be necessary to verify results. Suggestions for future research and the wider implications of the study will be covered in the concluding chapter.

The exploratory, mixed-methods approach allowed (a) rich information to be gained from conventional, biological, and organic participants regarding their choice of practices and production system, (b) these insights to be supported or rejected by quantitative means, and (c) theory on

farmer decision-making to be developed. The mixed-methods approach used has allowed for a broad spectrum of voices to be heard and a level of detail to be given that allows us to offer suggestions and indications that may answer the research question and address the objectives.

In this study, multiple sources of information (interviews, questionnaire, and literature review) have been used to establish a chain of evidence. The number of 30 participants in the qualitative phase was deemed to be sufficient as saturation of new information was reached about halfway through. It is, of course, possible that some ideas were not captured through these 30 participants but the likelihood is deemed to be low due to the care taken to stratify the sampling (different regions, different production systems, different stage in life, different processor etc.). Further evidence to the legitimacy of the data collected came from the respondents' ability to add other reasons for choice of system or areas of concern that were not listed by the researcher.

Given the large amount of data, the use of NVivo to analyse the material proved to be suitable. It was beneficial to use an approach similar to Grounded Theory, as well as a coding tree constructed around the conceptual framework, to be able to identify additional factors of importance. Without this process, significant events and autonomous motivation would not have been identified as additional factors.

7.6.1 Interview limitations

As Table 5 in Section 4.2.2 shows, some participants were referred by their friends, neighbours and acquaintances. Hence, there is a possible network effect where answers could be similar due to those farmers' relationship. Analysing the material, the main similarities between participants could be found between participants G and H. They were referred by the same consultant, and it became evident during the course of the interviews that these participants' thoughts and ideas were often strikingly similar. This similarity is most likely due to their use of the same consultant and the influence he has had on their thinking. Hence, care was taken during qualitative analysis to avoid using quotes from both participants as evidence for a particular theme. Other network effects were deemed to be negligible. In three cases, an agroecological participant referred a conventional neighbour. These participants had very different systems in all cases and different reasons for choosing that particular system. In one case, an agroecological participant referred an ex-employee who now has her own farm. Although both agroecological, the systems were very different in size of operation, with one having a small number of cows marketing raw milk directly to consumers, and the other having a larger-scale operation supplying a dairy company. Although their perceptions of the world were similar, the systems were different enough not to yield any evident network effects, although there can be no guarantees that network effects do not exist between

them. Similarly, one conventional participant referred another conventional participant, but these farmers also operated different systems in terms of scale of operation and geographic location. The similarities between these participants were also not conspicuous. The other 19 participants were unrelated to each other as far as was possible to tell. Due to organic farmers being a relatively small group in New Zealand, organic participants knew of each other (especially those who have been organic for a long time). It is difficult to appreciate just how much their thoughts have influenced each other as the depth of their relationships and personal history is not known. Despite the possibility of network effects, differences in decision-making were observed among the factors included in the conceptual framework.

Semi-structured interviews proved an effective data collection method. All participants were able to validate, review and comment on a document outlining the key messages taken from their interview summarised by the interviewer. Twelve participants took the time to make changes or respond to my email asking for feedback. This lends further strength to the use of their data as evidence, as it provides further indication that the participants believed their opinions and perspectives had been accurately represented. This verification step is deemed essential and a useful tool to use in similar studies. It is likely that those participants who did not reply either did not have the time to look through the document, or were not too concerned about the content.

7.6.2 Survey limitations

The web questionnaire was constructed to provide either support or rejection for the findings from the interviews by using a larger number of informants, thus acting as a complement to the qualitative phase. Focus was placed almost exclusively on threat and coping appraisal, since it had become clear during the interviews that there were differences in perceptions and reasons for their choice of practice or system in regard to big-picture changes in industry and society. This meant, however, that the factors acting on those processes and on the intention to act were not covered in the survey. This was deemed suitable as the qualitative phase provided rich data on those factors that accounted for the variation seen in the main processes. Given the richness of the interview data, it seemed prudent to focus the web questionnaire on what was identified as the main decision-making processes in this study.

Although the questionnaire was designed to focus on threat and coping appraisal, some elements of those processes were not tested directly. In threat appraisal, the severity of potential threats were tested extensively with the section on perceptions of the dairy industry. The vulnerability of the farm business to these threats and the rewards of maintaining the current practice or system were not tested directly, however. For example, participants might perceive that there are threats

to the dairy industry and show great concern, but are themselves not contemplating any major changes to their farming system because they feel that their system is not vulnerable. The rewards of maintaining the current system might thus be high in comparison to the costs of changing. Including questions such as 'how vulnerable do you believe your farm system is to these concerns?' and 'how likely are you to maintain your current system in response to these concerns?' would have been beneficial, which is something to bear in mind for future studies.

Similarly, coping appraisal was mainly tested through response efficacy omitting perceived behavioural control, self-efficacy, and response costs, which were part of the conceptual framework. These factors were thought to be covered through the three open-ended questions at the end of the survey, but only about 60% of respondents answered these questions and the answers themselves varied greatly in detail. The factors could essentially have been explored with the use of questions such as 'how likely is it that you will reach your ideal future farming system?' and 'how confident are you that you can reach your ideal future farming system?' which would have explored any external or internal barriers. Although the inclusion of these types of questions would have given richer detail and would have been favourable in hindsight, the survey as it was designed served its purpose well in providing support for some of the main processes of decision-making.

Although web surveys are both inexpensive and fast to create, a serious disadvantage is that the researcher has very little control over who gets access to the survey. To maximise who would be able to gain access to the questionnaire, it was created so that it was compatible with mobile viewing as well as on computers. Even so, not all possible respondents may have had access to computers or mobile devices, nor, possibly, the technological capability. In 2017, 91-93% of the New Zealand population had access to the internet either through an internet connection at home or via a mobile connection (InternetNZ, 2017). Therefore, there was potential for the survey to be widely accessed online.

Another limitation, however, was access to, and use of, Facebook to access the questionnaire as this was the primary method of survey distribution since no access to a database of dairy farmers could be found. The link to the survey was published in groups that had high numbers of members and active members. The highest recruitment rate was found in the group 'NZ Dairy Association', which had the second-largest number of members with a very active community. Unfortunately, this method of recruitment excludes any dairy farmers who do not use Facebook or who do not belong to the Facebook groups targeted. The online article that was published by the Rural News Group (2018) about the research midway through the collection phase, however, would possibly

have reached a population that did not use Facebook or were not members of the particular groups targeted. All respondents used an anonymous link to access the questionnaire, so it is impossible to give exact numbers of respondents from each distribution method.

There is a good spread of educational background, background in dairy farming, family situation, and gender among the respondents, but whether these are representative of the dairy population as a whole is unknown. Despite this, and the relative similarity of position on farm, location, and stocking rate, bias of results cannot be ruled out due to the use of mainly Facebook to attract respondents. It is likely that dairy farmers with larger farms are overrepresented in the sample as the respondents' average number of cows was 523 in comparison to the national average of 431. Therefore, the results of this study should be seen as indicative that needs further study to be verified.

Another consideration is that only people who were interested in the topic of research were going to complete the questionnaire. The more the respondent is interested in the research, the more detailed and accurate the answers are likely to have been (Flick, 2011). It must, therefore, be recognised that an unknown percentage of dairy farmers may not have made their voices heard by taking part in the survey, which could, of course, skew the results. On the other hand, the accounts of those respondents who took the time to complete the survey (approximately 10-15 minutes) are assumed to be honest accounts. It is believed to be a strength that the respondents can be assumed to be honest in their responses due to their interest in the research topic. It must, however, be recognised that responses of dairy farmers who were uninterested in the topic but could have made a useful contribution to the richness of the data may not have been included.

The survey included all respondents regardless of position on farm, whereas the interviews were largely focussed on owner-operators to receive input from those with the most decision-making power. Subsequent data analysis found that position on farm did not show any significant differences in the choice of, and reasons behind, choosing a certain practice or production system nor on perceptions of the dairy industry. The different sampling methods for the qualitative and quantitative phase of the mixed-methods approach indicate that there are few major differences between farmers based on job position.

7.7 Theoretical implications

Farmers are not a homogenous group, and decision-making can, therefore, not be seen as a deterministic relationship between factors that will lead to similar outcomes (Ohlmer et al., 1998). Every farm is also different in their biophysical characteristics, which can determine which options are feasible to adopt. The model presented (Figure 26) should, therefore, not be viewed as a

deterministic relationship but more as a dynamic process. As has been discovered and discussed in this thesis, the participants interviewed in this study cannot be easily placed into mutually exclusive groups. Dairy farmers and their chosen systems represent a continuous spectrum. Although production system group was able to explain most of the variation in motivations for production system and perceptions on the dairy industry in the web questionnaire, it also showed that respondents had similar reasons for choosing lower intensity, lower input systems irrespective of which production system group they belonged to.

7.7.1 Profit and wellbeing over production

Some participants expressed strong views that profitability in dairy farming has declined to such an extent that new ways of creating value beyond increasing production and capital gain are required. This was supported by respondents who showed great interest in supplying value-added milk products. The stress that the goal of increasing production has entailed was evident in some of the testimonies where participants explained the impact it had on themselves and their families to the point where it was essential that change of some kind had to happen. Perhaps this feeling is exacerbated by previous governments having encouraged farmers to intensify production (Chamberlin, 1996), which some participants in the interviews argued have been instrumental to creating the environmental problems experienced today.

Almost half of conventional and agroecological participants had come to a similar conclusion that "getting off the treadmill" of consistently pushing for higher production was necessary. Instead, aiming for higher profit per hectare rather than production per hectare became the aim in an effort to also improve wellbeing. There were both similarities and differences in how these two groups anticipate reaching that goal. Strategies included opting for a more grass-based, self-contained system (i.e. moving towards a System 1 or 2 on the DairyNZ system scale), diversifying income streams, or opting to produce value-add dairy products. A surprising number of participants said that they strongly believe in a quote from agribusiness accountant Pita Alexander: 'profit is for sanity and production is for vanity'; despite lower production, the farmers might retain their profit margin by focussing more on profit per hectare rather than production per hectare. Sometimes, adopting a low-input system was a precursor to adopting an agroecological system.

It was clear from the interviews as well as from the web questionnaire that participants and respondents request research into all kinds of systems to be better able to make decisions that allow them to choose a system that can uphold the value placed on profitability and wellbeing. Being able to access "honest" information on these systems as well as the impacts of them on the environment may thus enable autonomous motivation to change practices or production system

with little government or industry intervention. There were clear calls for authorities and policy-makers to be more inclusive, listen more to farmers, and acknowledge and trust the work and changes they are already undertaking. The practical implications of these findings for governance is explored in Section 8.2.

7.7.2 The nature of change and response

The nature of the stress the farmer and farm business is exposed to influences the strategies farmers use to respond. Either the buffer capability of the business is adequate and no, or marginal, system change will occur, or adaptation or transformation is required, and the farmer needs to explore which options are the most suitable (Cowan et al., 2015; Darnhofer, 2014; Darnhofer et al., 2011). Based on the findings in this study, perception of stress can be either a sudden or a slow process, or a combination of the two. Similarly, Ohlmer et al. (1998) stated that a problem could slowly grow in the mind of the farmer until it reaches a level where it becomes significant. Both sudden and slow events may assist in the perception that a tipping point has been reached that elicits the search for alternatives. This is similar to Darnhofer et al. (2011), who suggest that slow changes as well as sudden disturbances to the overall farm system may elicit one of two major responses: perseverance in the current system or exploration of new options. Furthermore, the authors note that the different strategies can be adopted simultaneously and the relative advantage of each changes over time depending on natural, economic and social capital. Darnhofer et al. (2011) also note that the perception of risks and opportunities as well as of slow versus sudden changes largely will depend on the individual, in agreement with Ohlmer et al. (1998). To put this in perspective with the research conducted in this thesis, the participants' responses to stress are summarised in Table 19.

Nature of change	Examples	Approach	Strategy	Response	Participants
Slow change	Consumer trends and regulation posing threats to business as usual	Perseverance; no, or marginal, change	Exploit OR Absorb	Current system buffers stress	C2, D2, E2, G2, H2, I2, J2, K2, M2, N2, O2
				Intention to change but financial constraints limits system change	B2, F2
		Exploration of new options; change in activities, in the use of resources or of the system	Adjust OR Transform	Appreciation of relative advantage leads to system change	B, D, F, G, H, I, K, L2, N, O
	Poor human, animal or soil health			Upholding values initiates system change	A, A2, C, E, J, L, M
Significant event					

Table 19. Overview of the different strategies adopted by the participants in this study in response to slow or sudden changes.

The different approaches, strategies and responses expressed by the participants are not mutually exclusive. For example, in response to a slow change (e.g. consumer trends), a dairy farmer could absorb some of the impact by improving efficiencies of the current system whilst also exploiting new markets (e.g. A2 milk if the farmer's cows carry the A2 gene). In this example, the current system would not undergo a major change or redesign. Similarly, a dairy farmer could in response to both a significant event and slower changes in society explore new options and make short-term adjustments (e.g. reduce antibiotics use) whilst preparing for long-term transformation of the production system (e.g. organic certification).

As defined by Darnhofer (2014), farm resilience includes the capability to buffer, adapt and transform. She defined buffer capability as the ability to reallocate resources in times when a sudden change, such as a drop in milk price or a drought, occurs. This is a useful capability when coping with small disturbances. Adaptive capability is the ability of the farmer to change the system in the face of greater disruption that builds up over time, such as a change in policy. Adaptations could include implementing precision farming or buying a different breed of cattle, which are akin to the processes of 'improving efficiencies' and 'substitution' as described by Hill (1998) and discussed by Pretty et al. (2018). Adaptive capability implies being flexible and being able to experiment but does not imply that the farmer has changed his or her goals and values (Darnhofer, 2014). By contrast, transformative capability is related to shifts in understanding and appreciating new conditions, which could induce a system redesign in times of perceived crisis. A perceived crisis

could make it more likely to adopt an agroecological production system in response to changing conditions (Darnhofer, 2014). This type of change has been termed 'redesign' (Hill, 1998; Pretty et al., 2018) and is an example of transformative change (Darnhofer, 2014). A similar framework has been proposed by Cowan et al. (2015) in their study on personal and family domains' influence on path dependence of farmers. They propose that a farm system will retain its steady-state if it is able to absorb a change within existing farm practices. If not, the farmer will have to adapt and make alterations to the system to retain system resilience. If this is not possible, the farmer may have to transform the business by either making a structural adjustment in terms of output or exiting the industry altogether. They propose that a shock or significant event would have the capacity to encourage adaptation. Cowan et al.s' (2015) findings on significant events are supported by the findings from the qualitative phase of this research.

Although the sample sizes of this study are relatively small and would need verification from further research, the changes considered or adopted by participants and respondents indicate that there is a general move towards and interest in redesign through improving efficiencies and substitution of practices. Most of these changes appear to be of an autonomous nature without much external pressure. Hill (1998) describes this process as going from unsustainable conventional practices (e.g. input-intensive and linear management for maximum production), through shallow sustainability (e.g. integrated pest management and use of alternative inputs to improve maintenance) towards deep sustainability (e.g. prevention of disease and seeing the farm as an ecosystem to optimise production through maintenance). Hill's (1998) definition of sustainability is mainly focussed on environmental and ecological aims, whereas this thesis takes a wider approach to sustainability incorporating financial and social aims as well. The progression observed towards more sustainable practices in this study is a mixture of all those aspects of sustainability, including improving wellbeing, improving profitability, and improving environmental impact. I firmly believe that this approach is necessary to include in all studies on farmer decision-making as nothing exists in isolation and a reductionist approach is unlikely to paint an accurate picture of the complexity around changes of practices or production system (Gosnell et al., 2020).

7.7.3 Need for holistic systems thinking

Farmers, as entrepreneurs based around the family home, juggle multiple goals of the business as well as those of family members, which could be seen as a constraining factor of adaptation decisions (Cowan et al., 2015). In order to uphold values and meet the goals of both family and business, farmers constantly review their system, detecting threats and opportunities by observation and evaluating consequences ((Darnhofer et al., 2011; Ohlmer et al., 1998). Because every individual has her own, unique set of goals, values, and beliefs, each individual will react

differently in the face of harm/loss, a threat, or a challenge (Folkman, 2013). How resilient a farm business is perceived to be to outside stresses is evaluated through the intra- and interpersonal factors of both the farmer and his or her family (Cowan et al., 2015; Pannell et al., 2006).

It has been suggested by Kaine (2004) that farmers act more as consumers than businesses when making decisions due to family life being tied to that of lifestyle and business objectives. Arguably, stakes are a lot higher for family farm owners than for other business owners as their home is their workplace, and vice versa. As such, making the correct decision in response to pressures is vital for the farmer and his or her family. An exception to this would be corporate farming models where the farm owner perhaps has investments elsewhere or has no physical ties to the land or any managerial input on day-to-day activities. In these cases, family events may have little to no influence on decision-making as their goals and values are not directly tied to the farm. The final model of decision-making presented in this thesis allows for these differences to exist although the main processes will be the same. The strength of and presence, or absence, of certain influential factors are not defined or weighted by the model. The model is thus constructed to account for the variation that exists between individuals' characteristics, their personal and situational context, and the time in which the decision takes place. These are depicted as moderators to the main processes of decision-making. As such, there can be no weightings of these factors, which has the implication that the model retains its simplicity in order to satisfactorily tell a complex story.

8 Conclusion

Dairy farming is one of the most significant primary industries in the New Zealand economy (Stats NZ, 2019b) and accounted for 28% of total export earnings in 2017 (Stats NZ, 2018b). The industry has, however, been subject to a lot of negative publicity domestically regarding its impact on the environment and on the country's 'clean and green' image (e.g. Kedgley, 2014; Ministry for the Environment, 2001; O'Tracey, 2017; Piddock, 2017; Shepard, 2017). Environmental regulation has been put in place to counter these effects in an effort to protect the environment but also to keep international and domestic consumers content and to protect Aotearoa New Zealand's share of the dairy market. Despite these efforts, consumers are changing their preferences and dairy farmers are reporting decreasing levels of wellbeing due to the perceived negative perception from the public and consumers. Alongside these stresses, farmers are also challenged by financial constraints, changing climate, and industry changes, to name but a few. Understanding how farmers perceive these stresses, how they respond and why, and what they believe the future of their industry will hold for them and their chosen practices or production system is vital. Therefore, the overall aim of this study was to understand dairy farmers' decision-making when considering whether to change practices or production system in response to external stresses. This was achieved by addressing the following objectives:

1. To identify which practices or production systems dairy farmers choose to adopt or have adopted
2. To identify the reasons for these choices, in particular why dairy farmers choose to adopt agroecological production systems
3. To synthesize theory with the results from objectives 1. and 2. to show the main processes involved in dairy farmers' decision-making.

A variety of contextual, external and inter- and intrapersonal factors were described in Chapters 2 and 3 as having an influence on how farmers decide which practices and production systems to adopt in response to external stresses. To explore these influences, this study required a comprehensive methodological approach, as outlined in Chapter 4. It was essential to take an interpretivist approach in order to tell the story from the farmers' perspective. In Chapter 5, qualitative data collection showed that an expanded list of influential factors act on threat and coping appraisal whereas other factors have an impact on the intention to act. Chapter 6 provided support for the main processes involved in decision-making through in-depth questioning on perceptions of the dairy industry and society, and the relative advantage behind changing practices or production system. This analysis led up to the creation of the final model of decision-making

presented in Chapter 7. The model bears strong resemblance to the PMT but has been expanded to include further elements found to be of importance in this study. Chapter 7 also evaluated the results with regard to the methodological limitations of the study, and outlined the theoretical implications. In this concluding chapter, the research question and objectives of the study will be revisited and presented alongside a discussion on the practical implications of the study and recommendations for future research.

8.1 Research conclusions

The exploratory, mixed-methods approach used in this study enabled rich data to be gathered through semi-structured interviews, of which the main findings could be confirmed through a web questionnaire. As discussed in Section 7.6., the methodology is not without its limitations, which invites a degree of caution when reviewing the results and conclusions from this study. The questionnaire only examined the main decision-making processes identified from the qualitative phase to gauge dairy farmers' perception on severity of threats and relative advantage of their chosen systems. The final decision-making model (Figure 26), therefore, relies heavily on the interviews where dairy farmers explained how they make decisions based on subjective perceptions. Keeping these limitations in mind, the analysis of the data collected in this research has extended our knowledge on how dairy farmers make decisions on whether to change practices or production system in response to external stresses. The different options that dairy farmers are considering and the reasons behind those choices were identified, which were synthesised with theory to show the main processes involved in dairy farmers' decision-making in the final decision-making model.

Below follow some of the highlights of the research findings.

- **Farmers' decision-making is governed by subjective interpretation and perception of threats and opportunities, and how to cope with them, which has implications for policy design.**

As expected, dairy farmers' decision-making was found to be governed by a multitude of contextual and inter- and intrapersonal factors acting on the three main processes: stress on the farm system, relative advantage and self-efficacy. It is suggested that the decision-making process follows a similar pattern for all dairy farmers but the evaluation of each process is highly individual depending on their subjective beliefs and other unique characteristics. Other external factors also moderate behaviour once an intention to act has been formed. Furthermore, each decision is set within the socio-physical context of each individual, his or her farm, and society as a whole, illustrating the complexity of decision-making.

When designing policy, authorities need to take the subjective nature of dairy farmers' decision-making into account and understand that decisions are rarely based on objective reality. They need to understand the multiple factors that influence farmer decision-making that lie outside the issue that the policy wants to address (e.g. social connectedness, prior experience, and values), and how these might influence the implementation of the policy. The adoption of this holistic systems thinking by authorities is more likely to encourage farmer compliance and functioning relationships between the two parties.

- **Farmers' perceptions and context may change over time, which influences their response.**

The final model is designed to accommodate the varying strengths of the influential factors to reflect that the individual decision-making process changes depending on the problem at hand, the socio-physical context it is placed in, and the time at which the decision is made. As an example, it was found that the motivations for adopting an agroecological production system today were different from those prevailing a decade or more ago. Previously, values attached to care of the environment and human health were driving factors, and for some, significant events had a marked influence on the strength of those values and the farmers' perception of severity of the threat. At the time of the study, values related to low environmental impact were still an important part, but additional drivers, such as improving negative public perception and producing a product that consumers want to buy, were more evident. This is an example of where both slow and fast changes in society or in personal life can elicit the same type of response, albeit at different times.

Due to the change in perception and context over time, the nature of response may also change. Many participants talked about how time has changed their priorities as they became older, reached certain goals, or had children. With a change in priorities, some re-valuated their systems and, as a result, changed direction. As such, the factors within the model are not static and will vary in strength over time, depending on the context, and on the situation at hand, which will influence the farmers' perception of stress and whether they are motivated to change or stay the same.

- **There appears to be a general move towards adopting lower-input systems that improve profit and wellbeing rather than increasing production.**

An important contribution of this study is the identification of a variety of responses to positive and negative stress (challenge or threat). Participants in this study have adopted or are considering adopting a range of different practices, which they believe will improve their system, whether that is for financial, social or environmental reasons. In most cases, a mix of reasons contributed to the decision. It is important to note that the perceived benefits of the different practices or systems were of a similar nature (e.g. many chose a practice or system based on the belief that it would lead

to improved profitability and wellbeing). This indicates that, although individuals have different perceptions of the nature and extent of external stresses on their system, the outcomes they sought were similar. Which option farmers were considering, however, depended on their belief that the option would be effective in achieving those outcomes and that they were able to implement it.

Many participants explained how they wanted to choose a system in which they could de-stress, work less, and spend more quality time with family. Many discussed how any dairy system can be profitable and that a high-input and high-intensity system with high output does not necessarily equate to high profits. Furthermore, Figure 23 in Chapter 6 showed how there appears to be a trend towards wanting to operate lower DairyNZ systems such as Systems 1 and 2 in the future. These systems are generally more self-contained, less intense, and less reliant on imported feed from suppliers and other farms. The interest in supplying value-add products and diversifying income streams also shows the different choices that farmers are considering in order to improve profitability. These findings suggest that the value placed on profit and wellbeing may be greater than the value placed on increased production among these farmers. Verifying these findings in a larger study would, however, be beneficial as this was not directly tested.

- **Those interested in agroecological production systems seem to prefer biological as well as non-certified organic systems, indicating a perceived relative advantage that is not dependent on an external monetary incentive.**

This research suggests that there is a strong interest among dairy farmers in adopting agroecological production systems. Both the qualitative and quantitative data collected in this study imply this tendency, and that they were chosen due to perceived lower environmental impact, preference by consumers, and improvement of public perception. Of the two agroecological systems under investigation, there is a much greater interest in the biological production system than in the organic production system. Barriers to organic production have been shown to include the cost of certification, inflexibility, and insecurity about how to successfully handle weeds and animal health issues such as mastitis. Enablers, on the other hand, have been shown to include a monetary incentive through a premium, an already well-established market known to consumers, and public endorsement of organic practices. To verify these indications, further study would have to be conducted among a greater number of dairy farmers.

For many agroecological participants and respondents, it seems that a premium is not the main driver for change. The overwhelming interest among respondents in adopting uncertified production systems, either biological or organic, even though there is no external monetary incentive, supports this. Transition to these non-certifiable systems may be appealing because the

adoption of them, according to most agroecological participants, can maintain or increase profit margins due to lower animal health incidences and fertiliser costs. Interview participants who have made or are in the conversion phase of transitioning to agroecological approaches have mentioned lower costs, healthier cows, and flexibility as important reasons for their decision to change system. Factors other than direct payment for a marketable value-added product could thus act as sufficient incentives. The incentives for choosing a system that is certifiable or one that is not could be financial in both cases, but are different in that one relies on payment from dairy companies or other sources outside the farm system itself, whereas the other focuses on improving profitability from within the system. A future study investigating the adoption of non-certifiable systems would be very interesting.

8.2 Practical implications

These research findings suggest that larger societal changes, and their impact on perceived stress on the farm system, ought to have a prominent place in research on complex farmer decision-making. A more holistic view on the decision-making of farmers needs to be employed that takes contextual, geographical, personal, and socio-political factors into account. Simple moral and rational choice models do not do this sufficiently well (Darnhofer, 2014; Ohlmer et al., 1998; Pannell et al., 2006). To encourage a more holistic approach to regulating and effecting change towards more sustainable dairy farming practices or production systems, three suggestions are presented below.

8.2.1 Recognising values supporting autonomy

In the proposed integrated model of complex decision-making (Figure 26), 'threat appraisal' was renamed 'stress appraisal' in order to account for the three types of stress identified by Richard Lazarus (1999) and Susan Folkman: harm/loss, threat, and challenge. The renaming of the process to perception of stress on the system is meant to highlight the process of how the perception of threat can be transformed into a perception of challenge given appropriate information, skills or resources to cope with the situation. Ability to control the situation diminishes the feeling of stress and empowers people to change leading to increased self-confidence. Studies have shown that intrinsic motivation decreases as extrinsic motivation increases, due to the restriction of autonomy (Deci & Ryan, 2008a); if people are offered a choice, they experience a greater level of autonomy and higher levels of intrinsic motivation. If they are feeling controlled or pressured, intrinsic motivation is diminished because the need for autonomy is not met (Deci & Ryan, 2008a). In order to facilitate farmers' response to external pressures, policy makers and industry bodies should, therefore, aim to improve autonomous motivation by providing adequate guidance on the different options that dairy farmers could consider. This is proposed to improve farmers' sense of autonomy

in choosing a response that suits their goals and values, empowers them to make those changes in a manner that suits their context, and improves their wellbeing by reducing stress. As other scholars have noted, and this research reinforces, there is no one-size-fits-all response to the pressures facing dairy farmers.

If the psychological needs for autonomy, competence and relatedness are not satisfied, individuals' motivation, productivity and wellbeing will be negatively affected (Deci & Ryan, 2008a). If those needs are met, however, individuals become intrinsically motivated purpose maximisers and not extrinsically motivated profit maximisers (Pink, 2010). It also leads to greater persistence of behaviour indicating that a behaviour adopted through autonomous motivation has a greater chance of being maintained (Deci & Ryan, 2008b).

Policymakers and regulators need to acknowledge that the vast majority of farmers have a real passion for what they do, and often show a greater purpose than simply maximising profits. This research identified values that were related to work satisfaction, good animal welfare, a good lifestyle and time for family and friends, which has also been found in other studies in New Zealand (e.g. Fairweather, 2010; Hunt, 2008). To encourage successful transitions to different practices or production systems, the approach from policymakers needs to acknowledge and appreciate the values and goals held by the farmer and his or her family (Cowan et al., 2015; Ohlmer et al., 1998), and incorporate them into extension endeavours.

The regulations that are in place are not generally contested by the participants. Although some participants feel that their autonomy is being restricted by regulation, the main frustration among participants appears more centred around feeling that farmers are not consulted in the formation of policies and regulations. The frustration lies in the development and execution of the regulations, how the regulations keep changing, and how the regulations may invite unintended consequences. A long-term plan set by the government, following greater participation and consultation, has been suggested as a way to combat this, which would make farmers feel that they are more involved and that they retain more control over the situation.

8.2.1 Acknowledging options for farmers

To allow farmers to make a decision that best suits their system and unique conditions, policymakers and industry bodies would do well to acknowledge that there are multiple ways of addressing any given problem. Leaving it to the farmer to decide how to best deal with the problem would preserve the farmer's sense of autonomy, improve trust relationships between regulators and farmers, and would lead to more sustainable change in the long term.

For farmers wishing to convert to organic production, there is a fair amount of information available online and through organic organisations. Those participants and respondents who were interested in a biological or regenerative production system, however, emphasized that there was a lack of information and research that makes the transition to those systems more difficult. Many participants explained how they had to spend hours on individual research or take overseas trips to learn from experts to gain the experience and confidence necessary to go down their chosen path.

Le Heron et al. (2016) explains that, in the 1990s, there was a lack of encouragement and conflicting advice given regarding alternative practices such as biological farming within the dairy industry. They stress that, at the time, there was no capacity among New Zealand dairy farmers or capability among institutions to initiate biological farming. Although information and demonstration about these systems is slowly increasing in New Zealand, the peer-to-peer network is extremely important for many. Biological and regenerative production systems in New Zealand are a bottom-up approach and a grass-roots movement driven by farmers. The spread of this system is largely due to farmers demonstrating their practices and the benefits of them to other farmers. An excellent example of this is the group Quorum Sense. Starting as an initiative by three regenerative farmers in Canterbury in October 2018 (Quorum Sense, 2020a), the group has grown to include more than 3 000 members on Facebook (as at October 2020), where the members share problems, solutions, and information about biological and regenerative farming practices. In July 2020, MPI's Productive & Sustainable Land Use – Extension Services Fund recognised the value of this grassroots movement by giving them a $1.8 million grant to continue their extension work for three years (Quorum Sense, 2020b).

The greater the stress that the farmer experiences, the more probable it is that he or she will search for information on alternative options and share their problem with people in personal networks (Pannell et al., 2006). Social connectedness and hearing the thoughts and ideas of other farmers strongly enhances the ability of farmers to recognise a potential threat and assess its severity. Quorum Sense's success suggests that there is a need for this type of peer-to-peer learning using communities and networks that can support change and transition. This study suggests that peer-to-peer learning would be the most effective way to scale the use of these practices, a sentiment which is supported by Gosnell et al. (2020). It would thus be valuable for farmers if industry bodies, dairy companies and government were to acknowledge the existence of all types of production systems, and further enable demonstration and discussion groups, thereby increasing farmers' capability to respond to stresses.

Similarly, educational institutions, whether at school, university or other training colleges, are encouraged to provide learning and guidance to their students on the range of options that exists, as well as the advantages and disadvantages of each. They also need to emphasize the importance of using a holistic, multidisciplinary approach when analysing and choosing between options as agroecosystems are inherently complex (Gosnell et al., 2020). Graduates are thus likely to become empowered to choose between different options that suits them and their context best, if they are provided information and guidance on all different kinds of viable production systems.

8.2.2 The use of external monetary incentives

The interest in adopting biological, regenerative and uncertified organic and biodynamic production systems among respondents who took part in the web questionnaire raises the question of how effective external monetary incentives really are for encouraging practice change among farmers. Since uncertified production systems are not dependent on external monetary incentives in the form of premiums, which may eventually be removed, they could be considered more financially sustainable. Where practices are dependent on premiums, there is always a risk that practices will become disadopted if the monetary incentive is removed (Burton & Paragahawewa, 2011; Wilkinson, 2011).

I would argue that a disadoption depends on whether the farmer has recognised other benefits of the alternative system that outweigh the existence of the premium. Indeed, many participants mentioned that farmers who adopt organic practices might do so because of the monetary incentive, but once they are operating an organic system, they realise other benefits and would not revert to conventional production even if the premium were to be removed. An external monetary incentive might thus pique an interest in alternative practices and encourage their adoption, but should not be the basis upon which the system is maintained. A conversion premium would be useful, however, as participants have reported that it does take time for the new system to be operating at its full potential.

Since monetary incentives may be withdrawn from certified organic production, it may be considered that converting to a biological or regenerative system will be more maintainable. Farmers who have adopted these systems seem largely convinced that there are sufficient benefits for adopting this kind of system without direct financial incentives. Rather, there are indirect financial and social benefits as a result of sustainable environmental practices.

8.3 Future research

There are plenty of studies investigating the conversion from conventional to organic production systems, but very few that have examined biological or regenerative agriculture, and the spectrum

between organic and conventional. In New Zealand, exceptions, which examine biological farming, include an unpublished Master's thesis from the University of Auckland by Smith (2010) and an unpublished report by Jefferis (2010) from Lincoln University. Another exception is a book chapter on how biological farming was beginning to become more widely adopted by dairy farmers in New Zealand in the 1980s, only for the movement to lose momentum due to a national push for dairy expansion, the structuring of the Crown Research Institutes, and the formation of Fonterra in the late 1990s and early 2000s (Le Heron et al., 2016). At the time of writing (September 2020), a database search for peer-reviewed articles and books on 'regenerative agriculture' and 'regenerative farming' yields 177 and 49 sources respectively. Searching for 'biological agriculture' and 'biological farming' yields 1,716 and 316 sources respectively. By contrast, searching for 'organic agriculture' and 'organic farming' yields 10,833 and 23,078 results respectively. There is clearly ample opportunity for more research in the biological and especially the regenerative agriculture space. This thesis thus contributes to the field by providing a rich in-depth look into the motivations and decision-making involved in choosing these types of practices and systems, and can act as a starting point for further research.

If the movement lost momentum back in the early 2000s as described by Le Heron et al. (2016), it has certainly picked up now. In 2012, there were indications that interest in biological production was increasing (Magesan & McFadden, 2012). Now, eight years on, this trend is continuing. In a report from the Biological Husbandry Unit (BHU), Merfield (2019) writes that uptake and visibility of regenerative agriculture as a set of farming practices and a social movement has increased in New Zealand over the last five to ten years. This research confirms the interest in biological and regenerative systems among dairy farmers, as well as the interest in organic systems. Based on these indications, the time seems ripe for research that investigates the feasibility of biological and regenerative practices. Peer-reviewed research on alternative systems and demonstration from practitioners of these types of systems may thus add to the knowledge base of farmers evaluating different adaptation or transformation options for their business in the face of stresses.

8.3.1 Preference for adopting biological systems

Farmers often adapt practices to suit their circumstances (Pannell et al., 2006) which may offer a possible explanation for why conventional respondents show greater interest in adopting a biological rather than an organic production system. A study on farmer decision-making processes by Ohlmer et al. (1998) showed that farmers particularly value flexibility in their system in times of change, enabling them to revert to previous practices if necessary. Certified organic production systems are often seen as input-oriented as practitioners have to adhere to strict rules and regulations that limit inputs, whereas biological, regenerative and uncertified organic and

biodynamic systems are based on outcomes and are not regulated by an external authority (Merfield, 2019). Gosnell et al. (2020), however, point out that there are two schemes currently available to identify and certify regenerative systems: the Rodale Institute's Regenerative Organic Certification (available in the United States of America) and the Savoury Institute's Ecological Outcome Verification (EOV) programme (international certification).

Although not significant at the adjusted *p*-level of 0.002, organic respondents, compared to biological and conventional respondents, indicated that their system was less flexible and that they felt less able to change things rapidly if needed (χ^2 (2, n = 166) = 9.835, p = 0.007). Organic respondents differed significantly to both the conventional (p = 0.005) and biological (p = 0.042) respondents when looking at pairwise comparisons. The view that certified organic systems were less flexible was also reported by participants C and F in the semi-structured interviews, who said that becoming certified organic would not suit them due to the inflexibility of the system. For those who perceive the organic system to lack flexibility in management options, this factor can be considered a barrier to adoption. A biological system based on outcomes might, therefore, seem more appealing as it involves greater flexibility, allowing the farmer to exercise greater control over inputs and management practices without fear of losing any certification. This flexibility would arguably allow the farmer to retain more autonomy, which has extensively been discussed as being important to farmers in this thesis. Research into the specific motivations for adopting a biological or regenerative system as opposed to an organic system would therefore be valuable to paint a richer picture of the motivations, barriers and enablers that exist.

8.3.2 The importance of norms, personality variables, and affect

A barrier to adopting certain practices or production systems could be the stigma some farmers feel is related to them and that their peers will disapprove. It was originally anticipated that norms would have a clearer influence over decision-making process in this study; Klöckner (2013) and Burton & Parangahawewa (2011) state that the impact of social norms should not be underestimated in their influence on the intention to act. Based on indications from the interview material, norms were tentatively divided into subjective norms and actual social norms in the final model of decision-making. The absence of interview material on norms does not equate to evidence of absence, however; it could be that norms were not prompted enough in the interview guide for them to come forth. Further research would thus be required to investigate this phenomenon more closely.

Personality variables is an original part of the PMT and was included in the conceptual framework as an influential factor to investigate. There is not strong evidence from the interview material that

participants regard them as major variables, however. Many did not spontaneously report them, which resulted in them being acknowledged as personal characteristics in the final decision-making model. This does not mean that personality variables are not important to the degree at which literature review suggests. The design of the interview questions were likely not designed to capture these variables in an appropriate way, indicating that further study would be needed to investigate the influence of these factors on dairy farmers' decision-making more closely.

Affect can be regarded as a motivation to maintain the use of a particular system. All groups rated 'I feel good using this system' among the top five reasons for choice of current system. However, current agroecological respondents were significantly more likely to rank it higher than conventional respondents indicating that the difference between the groups lies in the strength of that feeling. This finding is supported by a study on conventional and organic French farmers; Mzoughi (2014) found that organic farmers reported higher levels of subjective wellbeing, which was positively associated with profitability, work satisfaction, social recognition, and good health. Organic and biological respondents rated 'I feel good using this system' higher which may partly explain why none of the agroecological respondents indicated that they would revert to a conventional system in the future. This is supported by qualitative data from agroecological participants who mentioned that once people get into this type of system, they like it and never leave.

Affect thus has a part to play in maintaining the use of a particular system but could not specifically be found in this study to influence the decision-making process of changing to different practices or system. The questionnaire did not, however, contain a statement such as 'I believe I will feel better using this system' that respondents could rank as a reason for wishing to adopt their ideal future farming systems. This reason was excluded from the 'Future farming' section as it was thought that it would be difficult for farmers to know how they would feel in the future. In hindsight, however, it would have been sensible to include it as the strive to improve wellbeing appears to be a general reason for changing practices or production system. Not including this social factor is a limitation of the study. Many participants mentioned that operating an agroecological system has had positive impacts on their sense of wellbeing. Policy-makers may not necessarily consider the importance and value of farmers' wellbeing when they design regulations and other interventions aimed at influencing behaviour. Policy is often focused on specific outcomes (e.g. improved water quality) without fully accounting for the implications for wellbeing associated with regulation. The aspect of wellbeing is an essential part of operating a sustainable system and is, therefore, something that further research should look into more in order to determine the importance of affect in maintaining and changing systems.

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Appendix A: Research information sheet

RESEARCH INFORMATION SHEET

You are invited to participate as a subject in a PhD project entitled 'Understanding dairy farming decision-making'.

The aim of this PhD project is to understand the process through which dairy farmers who own and operate their own farms decide on their management strategy. Dairy farmers managing their farms using different systems such as conventional, biological and organic, will be interviewed and the results will be analysed both individually and in comparison. The research will elucidate any differences and similarities in the decision-making processes and may inform policy and/or extension programmes.

Your voluntary participation in this project will involve taking part in an interview that will last for approximately one hour. The interview will be recorded with your permission. If you do not wish the interview to be recorded, written notes can be taken during the interview instead.

As a follow-up to this activity, you will be asked to review a written account of the perceived main messages taken from the interview. Should you wish to, you will be given the opportunity to amend the written account.

You may decide to terminate the interview at any stage. You can also choose not to answer a specific question should you wish not to. You can also at any time withdraw from the project, including withdrawal of any information you have provided, up to a month after the date of the interview.

The results of the project may be published, but you may be assured of your anonymity in this investigation: the identity of any participant will not be made public, or made known to any person other than the researcher, her supervisors and the Human Ethics Committee in the event of an audit. To ensure anonymity the following steps will be taken:

- A code will be used in place of your name.
- No individual identifying information will ever appear in written or oral presentations.
- The location of your farm will only be recorded by dairy farming region so that it cannot be identified.
- All individual results will be aggregated at the group level.
- Any quotes from the interviews will be anonymised and used only with your express permission.

The project is being carried out by:

Christina Berneheim
0220 965 144, christina.berneheim@lincolnuni.ac.nz
She will be pleased to discuss any concerns you have about participation in the project.

Supervisors:

Dr. Gary Steel
03 423 0499, gary.steel@lincoln.ac.nz

Dr. Lin Roberts
03 423 0438, lin.roberts@lincoln.ac.nz

Dr. Christopher Rosin
03 423 0492, christopher.rosin@lincoln.ac.nz

The project has been reviewed and approved by the Lincoln University Human Ethics Committee.

Appendix B: Consent form

CONSENT FORM

Understanding dairy farming decision-making

I have read and understood the description of the above-named project. On this basis I agree to participate in the project, and I consent to publication of the results of the project with the understanding that anonymity will be preserved. I understand also that I may at any time withdraw from the project, including withdrawal of any information I have provided, up to a month after the date of the interview.

Please tick one of the following two boxes.

- ☐ I consent to having an audio recording made of my interview.
- ☐ I do not consent to having an audio recording made of my interview, but agree to notes being made.

Please tick one of the following two boxes.

- ☐ I consent that any quotes from my interview may be published and that these, in that case, will be anonymised.
- ☐ I want to review any quotes you would like to publish and may then give permission.

Name:

Signed: Date:

Appendix C: Interview guide

	Questions	Themes	Prompts
Part 1	Could you please tell me the story of how you arrived at managing your farm in this way? - What went behind your decision on employing your current practices? - Did anyone or anything specifically influence your decision? - What conditions made it possible to adopt this system? - Was there anything that made the process of starting to use these practices challenging/easy? - Is anything currently making it challenging/easy? - When did the decision take place? - What is the advantage of managing the farm this way rather than in any other way?	Norms, facilitating conditions, external knowledge, observational learning, habits, self-efficacy, perceived behavioural control	Was there anything that initiated the process? "You have mentioned X,Y,Z. Would you say that any of those or something else is your primary reason for your current set of practices?" Extra: Was there anything that signalled to you that the system you had previously was not optimal?
Parts 1 & 2	Please describe/tell me about yourself? - How do you manage your farm today? - How come you are a dairy farmer? - How long have you been farming? In this location? - What is your production system (DairyNZ's 1-5)?	Values, personality variables, prior experience	Number of cows, location, processor, time in biological/organic? Time on different location?
	Who or what would you say has an influence on what practices you decide to employ on the farm? - Who lives here? - Who works here? - Who makes the decisions? - Who do you supply? - Who came up with the idea? - Who are your supporters?	Social connectedness	Family, staff, other stakeholders, modifying influences, outside influencers

Part 2	What do you anticipate for/think of the future of dairy farming in New Zealand? - What are your thoughts about the dairy industry? - Do these thoughts influence your decision-making today? - Do any conditions (financially, socially and environmentally) challenge your system? Any constraints that could make it fall over? Anything that can make you change your system? - What has to happen to make the dairy industry better/improve it? - What are your goals? - Where do you see yourself in the future, in 5-10 years? - What are your thoughts on agroecological production systems? - Are there things that make the future uncertain? Things that you would rather have control over but you don't?	Threat appraisal, beliefs, attitudes, coping appraisal	As a business? As a family? Personally? Financial, production Regulations, consumer trends, environment. Any concerns, opportunities? Organic, biodynamic, holistic, biological
Ending questions	What in your view is the best thing about being a dairy farmer today? That was all I wanted to ask. Is there anything you did not have the chance to talk about that is important to you/care about? Anything else I should have asked you?	Affect	Participant determines when or if the interview is over

Appendix D: Transcription rules

Transcription rules adapted from Dresing et al. (2015, pp. 28-32).

1. Transcribe literally; do not summarize or transcribe phonetically. Dialects are to be accurately translated into standard language. If there is no suitable translation for a word or expression, the dialect is retained.

2. Informal contractions are not to be transcribed, but approximated to written standard language. E. g. “gonna” becomes “going to” in the transcript. Sentence structure is retained despite possible syntactic errors.

3. Discontinuations of words or sentences as well as stutters are omitted; word doublings are only transcribed if they are used for emphasis (“This is very, very important to me.”) Half sentences are recorded and indicated by a slash /.

4. Punctuation is smoothed in favor of legibility. Thus short drops of voice or ambiguous intonations are preferably indicated by periods rather than commas. Units of meaning have to remain intact.

5. Pauses are indicated by suspension marks in parentheses, corresponding to the pause length from one second (.) to three seconds (…), and the (number) of seconds for longer pauses.

6. Affirmative utterances by the interviewer, like “uh-huh, yes, right” etc. are not transcribed. EXCEPTION: monosyllabic answers are always transcribed. Add an interpretation, e.g. “Mhm (affirmative)” or “Mhm (negative)”.

7. Words with a special emphasis are CAPITALIZED.

8. Every contribution by a speaker receives its own paragraph. In between speakers there is a blank line. Short interjections also get their own paragraph. At a minimum, time stamps are inserted at the end of a paragraph.

9. Emotional non-verbal utterances of all parties involved that support or elucidate statements (laughter, sighs) are transcribed in brackets.

10. Incomprehensible words are indicated as follows (inc.). For unintelligible passages indicate the reason: (inc., cell phone ringing) or (inc., microphone rustling). If you assume a certain word but are not sure, put the word in brackets with a question mark, e.g. (Xylomentazoline?).

11. The interviewer is marked by “I:”, the interviewed person by “P:” (for participant). If there are several speakers, e.g. in group discussions, a number is added to “P” (e.g. “P1:”).

12. The transcript is saved in Word format (.doc file). Name the file according to the audio file name and the date when the interview took place. E. g. InterviewX_04022011.doc.

13. Discontinuations are marked by /: “I was worri/ concerned.” Word doublings are always transcribed.

14. Speech overlaps are marked by //. At the start of an interjection, // follows. The simultaneous speech is within // and the person’s interjection is in a separate line, also marked by //.

Notes for consistency

1. Symbols and abbreviations such as *percent* and *meter* etc. are spelled out.

2. Contractions and short forms are transcribed exactly as they are spoken, e.g. ‘can’t’ instead of ‘cannot’ or ‘stats’ instead of ‘statistics’

3. Concerning capitalization, words in different languages are spelled according to the rules of the English language.

4. Numbers are transcribed as follows:

a. Zero to twelve are spelled out, larger numbers are transcribed as numerals.

b. Numbers that make short words are also spelled out, especially round numbers: twenty, hundred, three thousand.

c. Decimals and equations are always written in numerals. Thus: “4 + 5 = 9“ and “3.5“.

d. Roughly estimated figures are spelled out, accurate figures are written in numerals, e.g. “The fifty million Euros in state subsidies“.

e. Follow established conventions regarding spelling. Street addresses, page numbers, telephone numbers, bank account numbers, dates etc. are never written out. For instance: “on page 11“ or “16 Broad Street“.

5. Idioms are transcribed literally.

6. If direct speech is quoted in a recording, the quote is put in quotation marks: and then I said “Well, let’s see about that.”

7. Single letters are always capitalized (“B like in bird”).

8. Enumerations: one capital letter without parentheses.

Appendix E: Questionnaire

UNDERSTANDING DAIRY FARMING DECISION-MAKING

The purpose of this survey is to understand the processes through which dairy farmers decide on their management strategies. Another purpose is also to understand dairy farmers' views on the future and hear their thoughts on what can be improved and how. The results of this survey will be used to inform policy-makers and industry, such as DairyNZ and MPI. It is therefore important that we receive feedback from a diversity of dairy farmers so please complete the questionnaire as much as possible.

This is an online questionnaire that takes about 10-15 minutes. Your participation is entirely voluntary. If you choose to participate, you have the right to decline to answer any questions or stop answering altogether at any time. The survey does not collect identifying information and your responses cannot be linked to you. All results from this study will be presented in an aggregated form; no individual responses will be presented. All data will be held on a secure server on the University campus in password-encrypted files.

Answering this questionnaire and clicking the 'Submit' button at the end of the questionnaire will be taken as your consent for the information you provide to be used in this research.
If you cannot finish the questionnaire all at once, your answers are temporarily saved automatically on the server so you can continue at a later stage. If you do not reactivate your session within a week of your last activity, your partial response will be deleted. The link to the questionnaire will be active until 31st December 2018. If you wish to withdraw your information from the survey, it may be possible to do so by contacting the lead researcher (Christina Berneheim) before 15th January 2019.

The survey has been reviewed and approved by the Lincoln University Human Ethics Committee. Christina Berneheim, from the Faculty of Environment, Society and Design at Lincoln University in New Zealand, is conducting this survey as part of her PhD project. Her main supervisor is Dr Gary Steel. If you have any questions or concerns about the research, you may contact them at:

Christina Berneheim
christina.berneheim@lincolnuni.ac.nz

Dr Gary Steel
gary.steel@lincoln.ac.nz

Thank you for participating!

Note: All questions marked with a symbol within parentheses ((%), (#), (*), or (€)) indicates that the question only became available to the respondent when selecting an answer with the corresponding symbol next to an answer to a previous question. The respondents could not see this display logic.

GENERAL INFORMATION	
Are you answering this questionnaire...	• ...on your own? (%) • ...with someone else? (#)
(%) Are you...	• Female? • Male? • I prefer not to say • Other, please specify
(#) With whom are you answering this questionnaire?	• Spouse/partner • Family • Friends • Other, please specify
What is your current family situation?	• No children • Dependent children • Grown-up children • Our children have children of their own • Other, please specify
What is your highest level of education?	• Primary school • Secondary school • Trades qualification (ITO course or similar), please specify the discipline • University, please specify the discipline • Other, please specify
What is your position on-farm?	• Farm owner who operates own business • Farm owner who employs a sharemilker or contract milker • Equity partner arrangement • Sharemilker • Contract milker • Farm manager • Farm worker • Other, please specify
What is your background in dairy? *Please select all that apply.*	• Raised on a dairy farm • Grew up rurally among dairy farmers • Went into dairy after education • Worked in other occupation prior to entering into dairy farming • Worked in other aspect of agriculture prior to entering into dairy farming. Please specify • Other, please specify

In which region is your farm located?	• Northland • Auckland • Waikato • Bay of Plenty • East Coast • Hawkes Bay • Central plateau • Western Uplands • Taranaki • Manawatu • Wairarapa • Nelson/Marlborough • West Coast • North Canterbury • South Canterbury • Otago • Southland
On a scale from 0-10, how dependent is your farm on irrigation? Please drag the slider to reflect your situation.	0 = Farming would be impossible here without regular irrigation 10 = Summer-safe, don't need any irrigation
CURRENT FARMING SYSTEM **This section allows you to describe your CURRENT farming system.**	
How often do you normally milk?	• Milk twice-a-day all season • Milk once-a-day all season • Use a combination of twice-a-day and once-a-day as the season progresses • Milk every 16 hours all season • Other, please specify
Which DairyNZ system(s) is used on your farm? *Please select all that apply.*	• System 1 - All grass self contained, all stock on the dairy platform. No feed is imported. No supplement fed to the herd except supplement harvested off the effective milking area and dry cows are not grazed off the effective milking area. • System 2 - Feed imported, either supplement or grazing off, fed to dry cows. Approx 4 - 14% of total feed is imported. • System 3 - Feed imported to extend lactation (typically autumn feed) and for dry cows. Approx 10-20% of total feed is imported. • System 4 - Feed imported and used at both ends of lactation and for dry cows. Approx 20 - 30% of total feed is imported onto the farm. • System 5 - Imported feed used all year, throughout lactation & for dry cows. Approx 25 - 40% (but can be up to 55%) of total feed is imported.

Which dairy company, or companies, do you supply? *Please select all that apply*	• Fonterra • Synlait • Open Country • Westland • Independent - we process on farm • Other, please specify
The following is an example of how to classify farming systems. Please read them, and select which option(s) describes your farming system best below. **Conventional** or industrial agriculture refers to farming systems which typically include the use of any or all of the following: synthetic chemical fertilisers, pesticides, herbicides, other continual inputs, irrigation, and tillage. Thus conventional agriculture is typically highly resource and energy intensive, but also highly productive. **Biological** or regenerative agriculture includes a reduction or complete absence of use of synthetic chemical fertilisers towards a focus on biological fertilisers that enhance soil biology. Practitioners often see biological farming as a middle-way between a conventional and an organic system and aim to achieve better plant and animal health through improved soil health. No certification is available. **Organic** typically means farming without synthetic fertilisers and pesticides. Instead it relies on crop rotation, animal and plant manures as fertilisers, some physical and biological weeding and pest control. Certification can be obtained through BioGro and AsureQuality. **Biodynamic** is similar to organic but uses locally sourced material for use as fertilisers and soil conditioners. Practitioners view the farm as a closed diversified ecosystem, and often base farming activities on lunar cycles. Certification can be obtained through the Bio Dynamic Farming and Gardening Association. *Please select all that apply.*	• Always conventional (&) • Always biological • Always organic • Always biodynamic • Certified organic • Organic but not certified • Certified biodynamic • Biodynamic but not certified • Used to be conventional, now biological • Used to be conventional, now organic • Used to be biological, now conventional • Used to be biological, now organic • Used to be organic, now conventional • Used to be organic, now biological • Other, please specify

(&) Have you ever tried biological fertilisers?	• Yes, with success • Yes, but not happy with the results • No, but am thinking about it • No, I don't believe in them • Other, please specify
Do you produce any of the following valued-added milk products? *Please select all that apply.*	• Winter milk • A2 milk • Organic milk • Grass-fed only • Raw milk • Other, please specify
Apart from milk production, do you have other income streams? *Please select all that apply.*	• Beef • Lamb • Cropping • Bull servicing • Stud sales • Tail up with wagyu or hereford to sell 4-day old calves for veal • Sell own produce on farm or in town • Other, please specify
Please drag the slider to reflect your current situation:	Stocking rate, cows/ha: 0 – 5
Please drag the slider to reflect your current situation:	Number of lactating cows: 0 – 2000
Please select the options that reflect the reasons behind your choice of your CURRENT farming system. <u>Likert-type response scale</u> Not relevant – Slightly relevant – Moderately relevant – Strongly relevant – Extremely relevant *If something you find important is not listed here, please write it down at the bottom under 'other'.*	• I know this system well from growing up • Was advised that this system is the best • Had to trial and read a lot before I chose this system • Saw other farmers adopt this system with success before I chose it • I feel good using this system • Low cost • High profitability • High production levels • Resilient to seasonal weather constraints such as droughts and floods • Resilient to fluctuations in interest rates • Resilient to milk price volatility • Resilient to fluctuating input prices such as fertiliser and feed • Resilient to biosecurity risks • Ease of management • The system gives me enough time for family and friends • The system is flexible and allows me to change things rapidly if need be • The system capitalises on available premiums/value-add

	• Low environmental impact • Resilient to any incoming regulations • The consumer wants this system • The use of this system can improve public perception • Good animal health • Good market access • Other, please specify: • Other, please specify: • Other, please specify:
FUTURE FARMING SYSTEM **This section allows you to describe your ideal FUTURE farming system.**	
	• I have an ideal future farming system in mind towards which I strive. (*) • I do not think that my current farming system will change much going forward. (€)
(*) How often would you like to milk in the future?	• Milk twice-a-day all season • Milk once-a-day all season • Use a combination of twice-a-day and once-a-day as the season progresses • Milk every 16 hours all season • Other, please specify
(*) Which DairyNZ system(s) would you like to use on your farm? *Please select all that apply.*	• System 1 - All grass self contained, all stock on the dairy platform. No feed is imported. No supplement fed to the herd except supplement harvested off the effective milking area and dry cows are not grazed off the effective milking area. • System 2 - Feed imported, either supplement or grazing off, fed to dry cows. Approx 4 - 14% of total feed is imported. • System 3 - Feed imported to extend lactation (typically autumn feed) and for dry cows. Approx 10-20% of total feed is imported. • System 4 - Feed imported and used at both ends of lactation and for dry cows. Approx 20 - 30% of total feed is imported onto the farm. • System 5 - Imported feed used all year, throughout lactation & for dry cows. Approx 25 - 40% (but can be up to 55%) of total feed is imported.
(*) Which dairy company, or companies, would you like to supply? *Please select all that apply.*	• Fonterra • Synlait • Open Country • Westland • Independent - we process on farm • Other, please specify

(*) The following is an example of how to classify farming systems. Please read them, and select which option would best describe your ideal future farming system below. **Conventional** or industrial agriculture refers to farming systems which typically include the use of any or all of the following: synthetic chemical fertilisers, pesticides, herbicides, other continual inputs, irrigation, and tillage. Thus conventional agriculture is typically highly resource and energy intensive, but also highly productive. **Biological** or regenerative agriculture includes a reduction or complete absence of use of synthetic chemical fertilisers towards a focus on biological fertilisers that enhance soil biology. Practitioners often see biological farming as a middle-way between a conventional and an organic system and aim to achieve better plant and animal health through improved soil health. No certification is available. **Organic** typically means farming without synthetic fertilisers and pesticides. Instead it relies on crop rotation, animal and plant manures as fertilisers, some physical and biological weeding and pest control. Certification can be obtained through BioGro and AsureQuality. **Biodynamic** is similar to organic but uses locally sourced material for use as fertilisers and soil conditioners. Practitioners view the farm as a closed diversified ecosystem, and often base farming activities on lunar cycles. Certification can be obtained through the Bio Dynamic Farming and Gardening Association.	• Conventional • Biological • Organic but not certified • Certified organic • Biodynamic but not certified • Certified biodynamic • Other, please specify
(*) Would you like to produce any of the following value-added milk products? *Please select all that apply.*	• Winter milk • A2 milk • Organic milk • Grass-fed only • Raw milk • Other, please specify

(*) Apart from milk production, which other income streams would you like to maintain or develop? *Please select all that apply.*	• Beef • Lamb • Cropping • Bull servicing • Stud sales • Tail up with wagyu or hereford to sell 4-day old calves for veal • Sell own produce on farm or in town • Other, please specify
(*) Please drag the slider to reflect your ideal future situation:	Stocking rate, cows/ha: 0 – 5
(*) Please drag the slider to reflect your ideal future situation:	Number of lactating cows: 0 – 2000
(*) Please select the options that reflect the relative advantage of your FUTURE farming system in comparison to your current and other systems. <u>Likert-type response scale</u> Does not describe my future system – Slightly describes my future system – Moderately describes my future system – Mostly describes my future system – Clearly describes my future system *If something you find important is not listed here, please write it down at the bottom under 'other'.*	• Lower cost • Higher profitability • Higher production levels • More resilient to seasonal weather constraints such as droughts and floods • More resilient to fluctuations in interest rates • More resilient to milk price volatility • More resilient to fluctuating input prices such as fertiliser and feed • More resilient to biosecurity risks • Easier to manage • The system gives me more time for family and friends • The system is more flexible and allows me to change things rapidly if need be • The system can capitalise on available premiums/value-add • Lower environmental impact • More resilient to any incoming regulations • The consumer wants this system • The use of this system can improve public perception • Improved animal health • Better market access • Other, please specify: • Other, please specify: • Other, please specify:

PERCEPTIONS **This section allows you to describe your perceptions of the dairy industry and outline what changes you would suggest would make life easier for dairy farmers going forward.**	
With regard to the current state of the dairy industry and its future, please indicate to what degree you are concerned (or not) about the following aspects. <u>Likert-type response scale</u> Not at all – A little – A moderate amount – A lot – A great deal *If something you find important is not listed here, please write it down at the bottom under 'other'.*	• Public perception of dairy farming • Unbalanced media reporting • Uneducated urban population on farming matters • Consumer trends • Biosecurity risks • Finding staff • Preserving the dairy pathway • Milk price volatility • Fluctuating interest rates • Debt serviceability • Family farms disappearing • Larger farms unable to have same attention to detail as smaller farms • Corporate farms' focus on production leading animal welfare and environmental concern to come second • Rural communities negatively affected by corporate farms • Unsuitable land being converted into dairying • Good farm land being converted into housing • Integrity of research - not sure if research can be trusted • Not enough on-farm research • Lack of independent advice from consultants and advisors • Industry bodies advocating for only a specific kind of dairy system • Students and young people not taught critical thinking and creativity • Research and university education tainted by agribusiness commercial interests • Agribusiness sees commercial gain as more important than improving farms' profitability • Agribusiness sees commercial gain as more important than protecting animal, human and planetary health • Profitability of dairy farming in general • The possibility of a capital gains tax • Too much regulation and red tape making dairy farming difficult • The cost of compliance

	• Government not providing long-term plan for dairy • Government not supporting dairy • Lack of available advice on how to adapt farming systems under incoming regulations • The environmental impact of dairy farming • The impact of dairy farming on the climate • The shift from pastoral dairy farming to farming in barns • Synthetic products entering the market • Market paying for quantity, not quality • New Zealand losing market edge by not living up to 'clean and green' reputation • Dairy companies not moving into value-add quickly enough • Not enough competition among dairy companies • Mental health among dairy farmers due to stress • Other, please specify • Other, please specify • Other, please specify
(*) What would help you reach your ideal future farming system? You can write as much or as little as you please.	TEXT-BOX ANSWER
(€) What would help make your current farming system easier to manage? You can write as much or as little as you please.	TEXT-BOX ANSWER
If you could choose freely, how would you improve the industry and dairy farmers' situation? You can write as much or as little as you please.	TEXT-BOX ANSWER
THANK YOU	
Thank you for taking the time to take part in this survey! *Please select all that apply.*	• Yes please, I do not mind being contacted with follow-up questions to this survey. Please enter your phone number or email-address here • Yes please, I would like to receive a personal copy of the final results of this survey. Please enter your email address here • No thank you, I do not want to be contacted or receive a personal copy of the results
Any questions, comments, thoughts or feedback you would wish to add?	TEXT-BOX ANSWER

If you think the results of this survey will be useful to the dairy industry, please help me distribute this questionnaire further by forwarding the link to your friends, neighbours and colleagues. Many thanks!